X PLANES

No: 8

Robert Forsyth

# BACHEM Ba 349 *NATTER*

X-PLANES 8

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SERIES EDITOR TONY HOLMES

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CHAPTER ONE

# ROCKET MEN

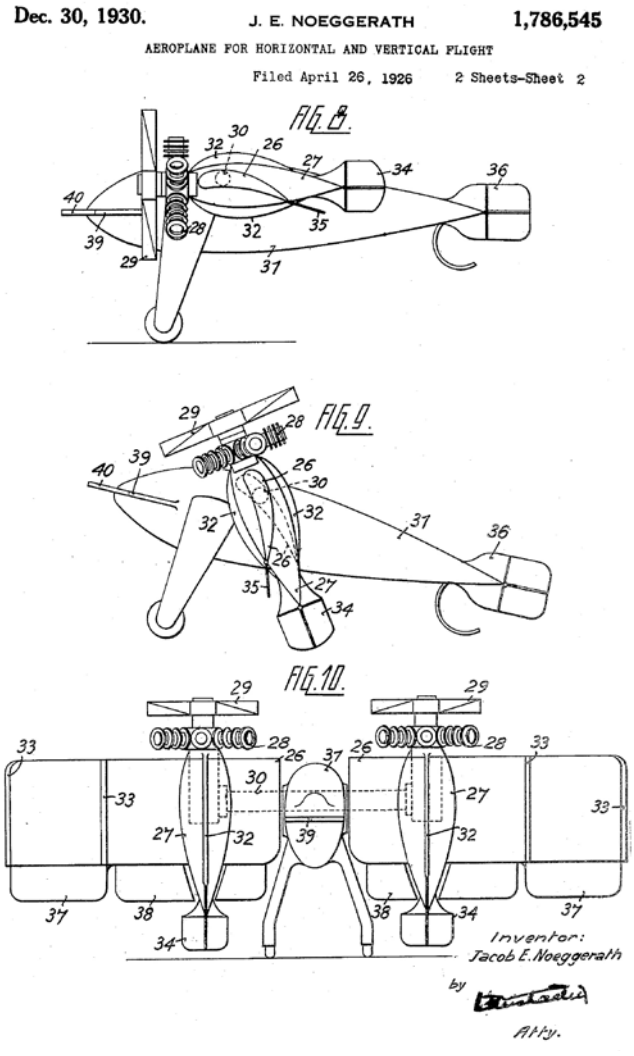
A view of a workshop in the Bachem factory, showing male and female workers producing sub-contracted aircraft parts, circa 1943/44.

The ability for an aircraft to take off vertically (and quickly), offering the advantages of a small operational preparation space combined with speed of readiness, take-off and climb, has set a challenge to designers of flying machines and aviators since the 18th century. However, it was in Germany that significant thought was given to the challenge. In April 1925, for example, Jacob Emil Nöggerath of Berlin filed a patent for an 'Aeroplane for Horizontal and Vertical Flight'. Nöggerath's design envisaged a standard monoplane fuselage, but with the ability of the machine's twin engines and propellers to pivot on their wings from the horizontal to the vertical, thus 'converting' it into a helicopter configuration with 'vertical rising' capability.

Nöggerath believed that, 'According to the present invention, vertical rising and landing is rendered possible by varying the length of the hull, either by making the hull in two parts capable of telescopic motion relative to each other or by providing means whereby the steering members such as the tail rudders can be folded down upon the hull, or in some other way. I have found that an ordinary aeroplane can be rendered for substantially vertical rising and descending by providing it with rudders and other steering or balancing surfaces which are considerably larger than usual, this increase of the size of the steering members being necessitated in view of the fact that the velocity of rising is much less than the velocity of horizontal flight.'

As the years passed, research into, and development of, helicopters – or autogyros – in Germany reached a degree of maturity during the early 1930s thanks, in principle, to the efforts of Professor Henrich Focke and Focke-Wulf, who conducted studies on

Berliner Jacob Emil Nöggerath created this flying machine, intended for 'vertical rising', in 1925. Even then, the advantages that VTO capability offered were recognized.




examples of the British-built Cierva C.30. Two such machines arrived at the *Reichsluftfahrtministerium*'s (RLM – Reich Air Ministry) *Erprobungsstelle* (test centre) at Rechlin in late 1934/ early 1935 for evaluation, but the subsequent report did not make encouraging reading:

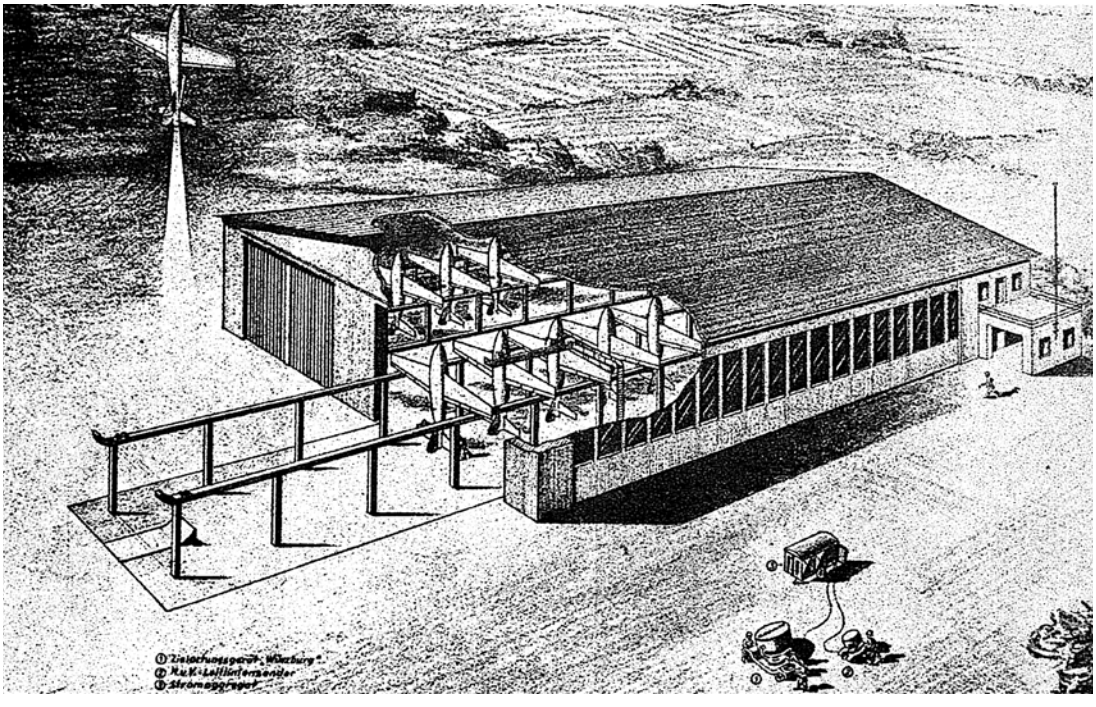
'A tendency after lift-off to turn around its horizontal axis. The autogyro did not climb quickly when flying through turbulence after a full-throttle take-off.'

From a military perspective, the reality was that the autogyro was slow and cumbersome. Versatile and strong as a design concept it may have been, but it could not serve as a fighter or bomber. Thus the creation of a combat aircraft that could combine the abilities of a fast and agile fighter with the versatility of an autogyro was a challenge, particularly – as the Rechlin technicians had noted – with regard to speed of climb after take-off.

Die Rakete
Zeitschrift des Vereins für Raumschiffahrt E.V., Breslau
Schwanzloses Raketenversuchsmodell.
Breslau 15. März 1928 2. Jahrg.

Development of high-power and high-speed rocket engines in Germany commenced as early as the 1920s. This is the cover of *Die Rakete* (*The Rocket*), the magazine for the Breslau-based *Verein für Raumschiffahrt* (Society for Spaceship Travel) from 15 March 1928, featuring a photograph of a young member of the society holding a model of a tailless experimental rocket.

Yet elsewhere within Germany, the solution to this was in progress. The development of high-power and high-speed rocket engines had been championed since the late 1920s, and there was almost a 'cult' of rocket pioneers. The small but dedicated *Verein für Raumschiffahrt* (VfR – the Society for Spaceship Travel) was formed in 1927 in Breslau to pioneer and advance research and development into interplanetary spacecraft, though its members operated on very tight budgets. Its membership included a number of the pioneers such as Johannes Winkler, Max Valier, Hermann Oberth and Klaus Riedel. Together with Fritz von Opel, in 1928 Valier had built rocket-powered cars and sleds that achieved speeds of up to 235km/h and 380km/h, respectively. The VfR published its own magazine entitled '*Die Rakete*' (*The Rocket*), which served to raise its profile amongst younger generations. One of the VfR's



In 1939, the young German rocket engineer Wernher von Braun put forward a proposal for the deployment of rocket-powered *Rückstossjäger* ('reaction fighters') as a means of high-speed, local aerial defence. Here is von Braun's vision of a hangar from which *Rückstossjäger* would take off to intercept enemy bombers. Visible also is a Würzburg radar, a beam guidance system and a generator for ground control purposes.

younger members was a student named Wernher von Braun, who recalled:

'I joined Klaus Riedel and Rudolf Nebel, two other members of the German Society for Space Travel, as Professor Oberth's assistants. Our equipment was elementary and our ignition system was perilous. Klaus Riedel would toss a flaming, gasoline-soaked rag over the gas-spitting motor and then duck for cover before Oberth opened the fuel valves and it started with a roar.'

By 1934, the activities of the VfR had prompted considerable interest within the German army, which offered the ambitious von Braun support in the development of liquid rockets if the association's members would agree to work under military supervision. Von Braun, and a number of his colleagues, needed little encouragement.

Also during the late 1920s and into the 1930s, the development of rocket engines had caught the attention of German glider pilots and aircraft designers. On 11 June 1928, Fritz Stamer flew a rocket-powered glider (designed by Alexander Lippisch) for the first time, and on 30 September of the following year, von Opel took to the air near Frankfurt-am-Main in another glider (designed by fellow pilot and glider-builder Julius Hatry) powered by a battery of solid-fuelled rockets. In October 1929, another glider pilot, Gottlob Espenlaub, attempted to fly his E 7 glider following the attachment of a pair of Sander solid-fuelled rockets. After a towed start, he managed to fly for about 300m on one rocket. A second attempt, in another glider, in May 1930 saw the craft explode after the rocket was ignited in flight. The glider dived into the ground moments later, resulting in Espenlaub being hospitalized.

It would be another nine years until, on 30 June 1939, Flugkapitän Erich Warsitz made a fully rocket-powered flight from the Baltic island of Usedom, lasting 50 seconds, in the Heinkel He 176 – a small five-metre-long monoplane, just 0.8m in diameter, powered by a Walter RI rocket engine fuelled by hydrogen peroxide and methanol. The He 176 was a purely private research venture on the part of the aircraft designer, Ernst Heinkel, and although it was not particularly impressive, with the Walter motor producing a maximum thrust of 500kg for 60 seconds, it proved that an aircraft could achieve sustained flight with rocket power only.

But what about purposeful military deployment? The following month, Wernher von Braun, who had been deeply involved with long-range rocket research and development at Kummersdorf and the recently opened, state-of-the-art complex at the *Heeresversuchsanstalt* (HVP – Army Research Institute) at Peenemünde, on the Baltic coast, put forward a rocket-fighter proposal in which he identified, aside from rapid climbing speed, the factor of mobility. Von Braun's idea was to use single-seat, rocket-powered *Rückstossjäger* ('reaction fighters') that could be launched vertically from mobile ramps carried on lorries. In effect, the *Rückstossjäger* was a manned missile with a motor of 10,160kg thrust fuelled by nitric acid and diesel oil. Armed with four machine guns, the fighters would be launched as late as possible, and at short intervals, following an alert, and be guided towards an enemy bomber incursion by *Würzburg* radars.

The RLM handed von Braun's proposal to Dr Heinz Motzfeld, a physicist and *Gruppenleiter* in the development section at the Ernst Heinkel Flugzeugwerke at Rostock-Marienehe. In his review of von Braun's ideas of October 1939, Motzfeld opined, 'The proposal of Dr von Braun contains several usable suggestions which merit further consideration. But the project will have practical significance only when it becomes possible to increase the height attained with the big rocket by several kilometres and extend the duration of flight with the smaller rocket drive by a considerable amount.'

Motzfeld subsequently poured more cold water on the proposal by stating that vertical take-off offered no tactical advantages. Furthermore, despite von Braun putting forward an enhanced proposal in May 1941, the RLM was convinced that the *Reichsverteidigung* could best be left in the hands of pilots flying conventional, piston-engined fighters, and so the plan was forgotten.

Notwithstanding this, the RLM subsequently passed the von Braun proposal to the Gerhard Fieseler Werke in Kassel for further study. Inspired by von Braun's concepts, supposedly under the designation 'Fi 166', Fieseler, in late 1941, came up with a project proposal for a series of rocket-powered or rocket-assisted, high-altitude fighters or *Höhenjäger* and submitted them to the HVP. After further study by Fieseler and the HVP, two refined project designs emerged – the *Höhenjäger* I and II. The *Höhenjäger* I was a single-seat, low-wing, jet-powered vertical take-off interceptor with limited endurance, while the *Höhenjäger* II was a two-seat design powered by a rocket motor produced by the Elektro Mechanische Werke (EMW) at Peenemünde.

Again, Fieseler saw ground mobility as an important requirement, with the ability to launch the *Höhenjäger* from the backs of vehicles. This version had an endurance of 45 minutes, which was believed to be enough time to make at least two attacks on an enemy bomber formation, and was crewed by a pilot and observer. As with von Braun's *Rückstossjäger*, it too would be controlled by *Würzburg*. The *Höhenjäger* II would be launched with the aid of a powerful booster rocket capable of getting the interceptor to its combat altitude of 12,000m, at which point it would be jettisoned and descend by parachute for re-use. The EMW rocket would then be engaged and landing eventually effected using a retractable skid.

But neither of the *Höhenjäger* developed beyond the drawing board because EMW became involved in the development of the *Wasserfall* radio-controlled surface-to-air missile, which assumed priority.

All of these proposals were eclipsed by the Messerschmitt Me 163 single-seat rocket interceptor, which began to equip the Luftwaffe's *Erprobungskommando* 163 from the spring of 1944 and later 1./JG 400. The diminutive, innovative and radical fighter was capable of operating at speeds of between 800–900km/h and attaining its service ceiling of 12,100m in just under three-and-a-half minutes. However, the Me 163 carried only enough fuel for eight minutes of powered flight. The rationale behind its manufacture lay in the need for a 'target defence interceptor' able to operate near to, and to protect, specific industrial areas (such as synthetic fuel plants) likely to be targeted by the Allied air forces. It first went into action against the USAAF's Eighth Air Force in July 1944, but results were not encouraging.

The prevailing air war over the Reich by mid-1944 was need enough for a fast-climbing, high-speed interceptor that could be cheap and quick to build, whilst incorporating the most advanced power technology. Rockets were being built as weapons under von Braun at Peenemünde, but what no designer had so far achieved was to put a pilot into a vertically launched, rocket-powered interceptor equipped with a formidable armament and send him into action against enemy bombers.

That was about to change.

NEXT PAGES

## CENTRAL GERMANY, SUMMER 1945

A Ba 349 *Natter* of a recently-formed factory defence flight, flown by a Luftwaffe volunteer, fires its nose battery of 32 R4M 55mm rockets as it approaches a formation of B-17 Flying Fortresses from behind and below during an Eighth Air Force raid on a synthetic fuel target in central Germany in the summer of 1945. The *Natter*'s external booster rockets have been released. Moving at a speed of between 300 and 600km/h, it would have taken the VTO interceptor seconds to reach the bombers' altitude. The Ba 349 would remain airborne for just two minutes before the nose and cockpit section separated from the main fuselage section and the pilot bailed out, parachuting to the ground. At such speeds, and being such a fast-moving small target, the *Natter* would have been hard for USAAF air gunners to track.

CHAPTER TWO

# PROJEKT *'NATTER'*

One man who was almost certainly involved at some point with Fieseler's von Braun-inspired concept for a vertical take-off rocket interceptor was *Diplom-Ingenieur* (*Dipl.-Ing*. – engineer's degree) Erich Bachem. He had been employed by the Gerhard Fieseler Werke since 1933, and in 1938, after being Technical Director, was appointed Chief of the Development Department, working closely with Gerhard Fieseler.

The son of a pharmacist, Bachem was born in August 1906 in Mülheim, in the Ruhr, and was descended from a Catholic merchant family from the Rhineland. Schooled locally, in 1925 he went on to study mechanical engineering at the *Technische Universität* (Technical University) in Stuttgart. By 1926, despite the shackles of the Treaty of Versailles which restricted the building and use of powered aircraft, Germany was viewed by many as the most 'air-minded' nation in Europe. Covertly, an ever-expanding infrastructure of flying schools and aero-clubs spread across the nation. Germany wanted, and needed, to achieve so much in terms of aviation and would do so, if necessary, by subterfuge. Rather than comply with the terms of the treaty, the Germans brokered clandestine agreements with sympathetic or neutral nations in a period that saw both rapid technological development and increasing competition in the business of international aviation.

Like many of his contemporaries, Erich Bachem wanted to play his part at the cutting edge of this advanced industry, and he joined an ever-growing band of young men and women who wished to both study design or engineering as well as learn to fly gliders, as a first step.

Local youths assist members of the Stuttgart *Akaflieg* to get Erich Bachem, a keen glider pilot, airborne in the *'Stadt Stuttgart'* glider, possibly at the Rhönwettbewerb (Rhön Contest) of 1933 – the year Bachem started work at Fieseler.

During his time in Stuttgart, he became close friends with Wolf Hirth, who would go on to become the most famous glider pilot in pre-Nazi Germany. Hirth was not only dedicated to the sport of gliding, but he was tough as well. During the 1922 Rhön competitions on the famous Wasserkuppe mountain, Hirth was injured when the S 10 high-wing glider he was flying, designed by Willy Messerschmitt and Friedrich Harth, crashed. Hirth's larynx was damaged in the crash, leaving him with a permanent speech impediment. In 1924, he lost a leg following a motorcycle accident, and he subsequently flew while wearing a wooden prosthesis – Hirth had the fibula from his amputated leg made into a cigarette holder.

Greatly influenced by his mentor, Hirth, Bachem also became a keen glider pilot and amongst others flew a glider named '*Stadt Stuttgart*'. He joined the Stuttgart *Akademische Fliegergruppe* (*Akaflieg*), which

Dipl.-Ing. Erich Bachem studies a model of the wooden BP-20/Ba 349 *Natter* interceptor, one of two creations that have earned him a place in engineering, aviation and transport history. The other is as designer of the world's first plywood camping trailer, in the 1930s, followed in the late 1950s by the ERIBA 'Troll' camping trailer, co-designed with Erwin Hymer.

had been set up by Hirth and the university's Technical Aviation Study Group in 1922 as one of a network of such organizations intended to coordinate the activities of aeronautical engineering students at German technical universities, and in particular gliding. When Hirth left for the USA in 1930 to promote the sport of gliding, Bachem took over the chairmanship of the *Akaflieg*.

That year, Bachem also completed his studies and worked as a designer in both Stuttgart and Berlin. Aside from gliders, Bachem designed an early camping trailer that was constructed, like a glider, from wood, and which was built by Wolf Hirth's own company, the Flugzeugbau Wolf Hirth. Then in 1933 he joined Fieseler.

Another member of the *Akaflieg* Stuttgart was Willy Fiedler. Born in Freudenstadt in the Black Forest in January 1908, Fiedler was a contemporary of Bachem at the *Technische Universität* in Stuttgart, from where he qualified as a *Diplom-Ingenieur* in 1933. An intelligent and resourceful man, Fiedler joined Bachem and Hirth in glider competitions in the Rhön mountains, flying gliders designed by the *Akaflieg* Stuttgart. After Stuttgart, he worked for a machine tool manufacturer in Bachem's home town of Mülheim, before enrolling with the *Deutsche Versuchsanstalt für Luftfahrt* (DVL – German Aviation Research Establishment) at Berlin-Adlershof, where he qualified as a Flugbaumeister (aeronautical engineer) and then joined Messerschmitt at Augsburg. Fiedler also undertook trials with a Zündapp motor-powered glider and designed a high-wing, single-seat trainer aircraft, the RM 2.

In 1937 he spent a year in England working for the British Aircraft Manufacturing Company Limited in Middlesex, which produced the German Klemm L 25 sports aircraft under licence. Returning to Germany, Fiedler re-joined the DVL briefly and also spent some time at the Luftwaffe test centre at Rechlin, but in 1938 he moved again to the Gerhard Fieseler Werke, where he once more came into contact with Erich Bachem. At Fieseler, Fiedler became involved in ground-testing and assessing new aircraft as well as test-flying them. He became a Flugkapitän on 29 March 1941.

That year, despite the success that Fieseler was enjoying with the Fi 156 Storch observation and liaison aircraft, Erich Bachem left the company in order to pursue his own interests. Good fortune was on his side, for the budding aviation entrepreneur was approached by the Württemberg Ministry of Economics, which was looking to encourage new business ventures into the area following the earlier closure of a large employer in the region. Thus it was that Bachem established his new company in February 1942 in the picturesque Upper Swabian town of Waldsee, just west of the River Rhine.

The new Bachem-Werk, also known as 'ERIBA' from ERIch BAchem, included a large production hall surrounded by various sheds, and was served by a spur line from the *Reichsbahn*. Bachem advertised itself as a specialist in '*Holz und Metallbau*' – 'wood and metalwork' – but the company's main line of business was the production of wooden aircraft parts, and the firm gained sub-contracts with major manufacturers such as Dornier, Heinkel, Fieseler and Hirth. During the course of

the war, Erich Bachem also became regarded as an accomplished designer of wooden aircraft, a reputation that went back to his time in Stuttgart. He became involved in advising on, and producing, wooden components for the Dornier Do 335 tandem-engined fighter, such as the leading edge for the tail unit which was crafted from laminated plywood. He was also consulted during development work on the Heinkel He 162 *Volksjäger* jet interceptor. Additionally, it is believed the Bachem-Werk was involved in the output of gliders and/or ultra-light aircraft.

Quite when the RLM's call to produce a cheap-to-build and, if necessary, disposable rocket-powered target defence interceptor reached Bachem is not known, but as mentioned in Chapter 1, in 1944 the weight of the Allied strategic bombing offensive against the Reich bore down sufficiently on the RLM, the Luftwaffe and German industry so as to increase the urgent requirement for a cheap (wooden with one engine), quick-to-build (small, single-seat), heavily armed (cannon and/or rockets), rapid-climbing and high-speed (rocket) interceptor able to glide to earth after use and be recovered. Furthermore, if such aircraft could be deployed in mass, the effect on the Allies' bomber formations could be significant.

To this end, although the RLM sought applications from aircraft manufacturers for such a design, the reality was that by the summer of 1944, the only high-speed aircraft just entering service was the Me 262

The entrance gates and gatehouse to the Bachem-Werk premises at Waldsee. The sign is adorned with the ERIBA logo and advertises the company as specialists in wood and metal construction. The building to the left served as the main production hall, with a yard in front. Just behind was a railway spur line off the Reichsbahn.

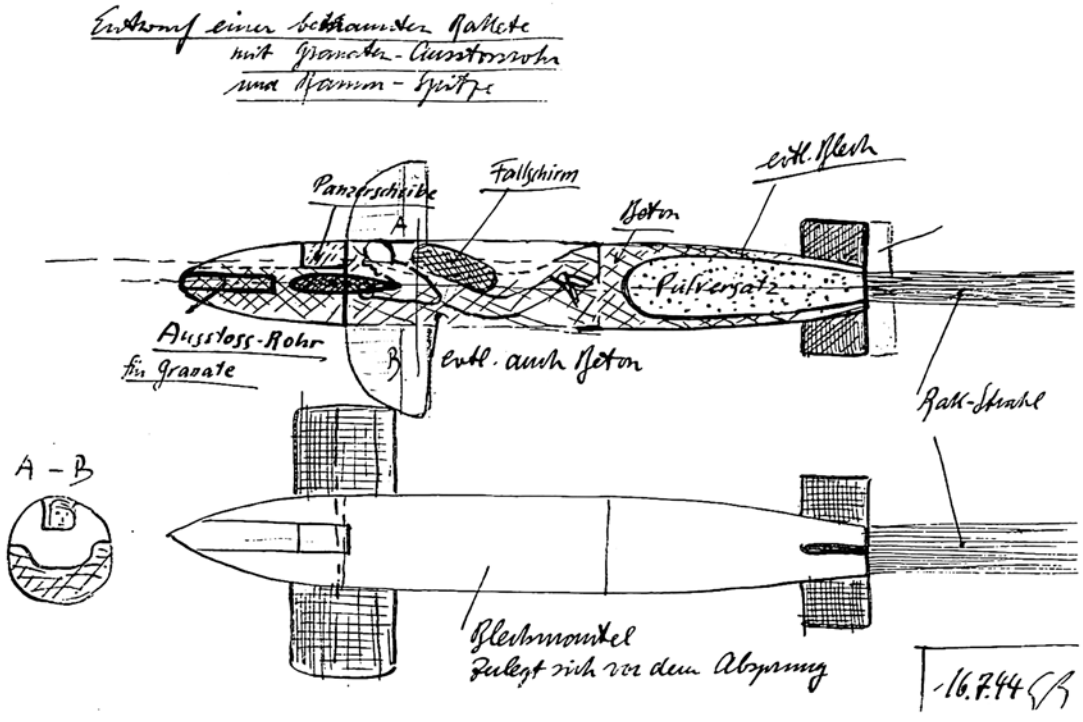
jet fighter, but it was doing so in small numbers, while the numbers of Allied heavy bombers operating in German airspace was increasing week by week. The Me 262 was also made of metal and powered by two complex jet engines, thus using up man-hours and being built with a high production cost.

When Bachem did eventually enter the arena, however, he would not be alone. In June 1944, Heinkel presented the design for a small, high-wing monoplane that would be launched into the air by a battery of four jettisonable Schmidding SG 34 (109-533) solid-fuel rockets, offering a thrust of 1,200kg each for a duration of ten seconds, which were attached to the design's fuselage. The brainchild of Dipl.-Ing. Wilhelm Benz and Dr Gerloff, it was referred to initially as '*Projekt Benz*', but later more commonly known as the He P 1077/*Julia I*. A plan from August 1944 shows the pilot laying prone in the nose, his 'aircraft' being powered by a Walter HWK 509 C-1 liquid-fuelled rocket motor manufactured by the Hellmuth Walter Kommanditgesellschaft. Capable of attaining an altitude of 5,000m in 31 seconds, its armament consisted of two 30mm MK 108 cannon on the sides of the cockpit. The *Julia I* would return to land using two extendable fuselage-mounted skids.

Quite what it would have been like for a pilot to 'experience' flying the *Julia* with its tiny accommodation, high speed with an acceleration of 2.05g and the noise of its rockets and cannon firing immediately next to the cockpit is difficult to imagine. An enhancement of the *Julia I*, the *Julia II*, dating from October 1944, incorporated seating for the pilot, and further proposed variants powered by Argus AS 044 pulsejets were assigned the name *Romeo*.

Some tests with a prone pilot were carried out by the *Flugtechnische Fachgruppe* at the *Technische Universität* in Stuttgart during 1943, and in September 1944 the RLM authorized further development and manufacture to continue with a batch of 20 P 1077s at the Wiener Holzwerke in Austria. If things went well, it was envisaged that 300 such craft could be produced monthly, but in late 1944, Wiener Holzwerke was badly bombed and most of the completed parts and associated documents were lost. Despite scale and full-size mock-ups being made, further bombing of the Heinkel works and the general conditions prevailing by February 1945 brought all further work on the *Julia I/II* to a stop.

Elsewhere during 1944, Junkers had produced a design for the Ju EF 127 *Walli*, a rocket-powered target defence fighter armed with a pair of 30mm MK 108 cannon and powered, like the *Julia I*, by an HWK 509 C-1 liquid-fuelled rocket motor. The aircraft was to take off using two underwing rocket-assisted units of 1,000kg static thrust each and a jettisonable three-wheeled trolley, which was to be released during the aircraft's climb to its operational altitude. Landing would be accomplished by the use of a skid. Although the RLM expressed interest in the project, it favoured a more simplified take-off system without a trolley, so Junkers investigated the use of a jettisonable undercarriage.




This is believed to be the earliest sketch produced by Erich Bachem, dated 16 July 1944, to illustrate his concept of an armed, manned rocket, showing the pilot lying prone behind a nose into which has been fitted a large-calibre shell or projectile. The pilot looks through an armoured glass panel and has a parachute strapped to his back.

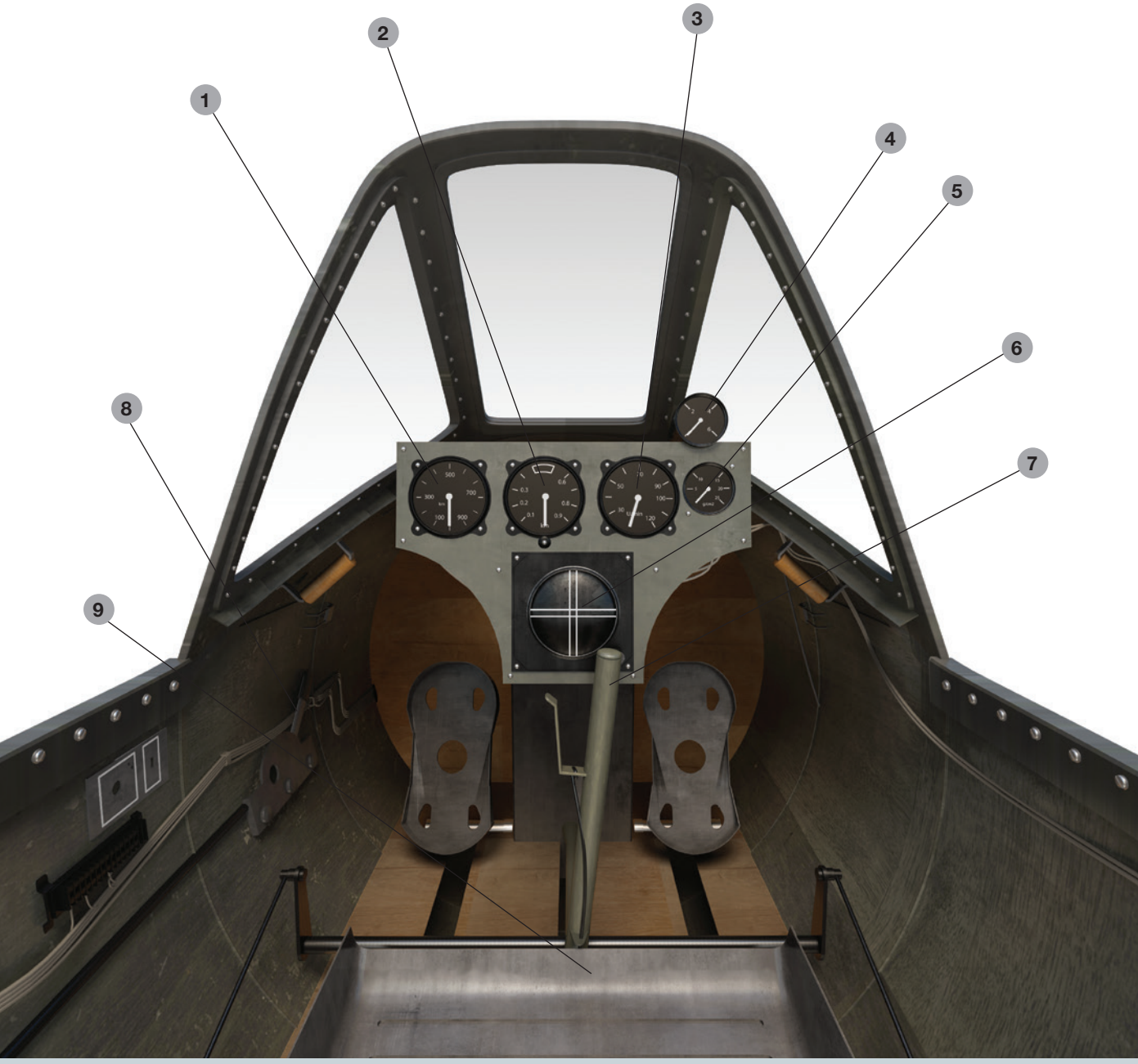
A range of other target defence fighter designs was produced by Messerschmitt, Arado, the Deutsche Forschungsanstalt für Segelflug (DFS) and Sombold for 'midget' and 'parasite' fighters, but few progressed beyond the drawing board. But for Erich Bachem, ironically, the worsening war situation and scarcity of expensive materials played into his hands.

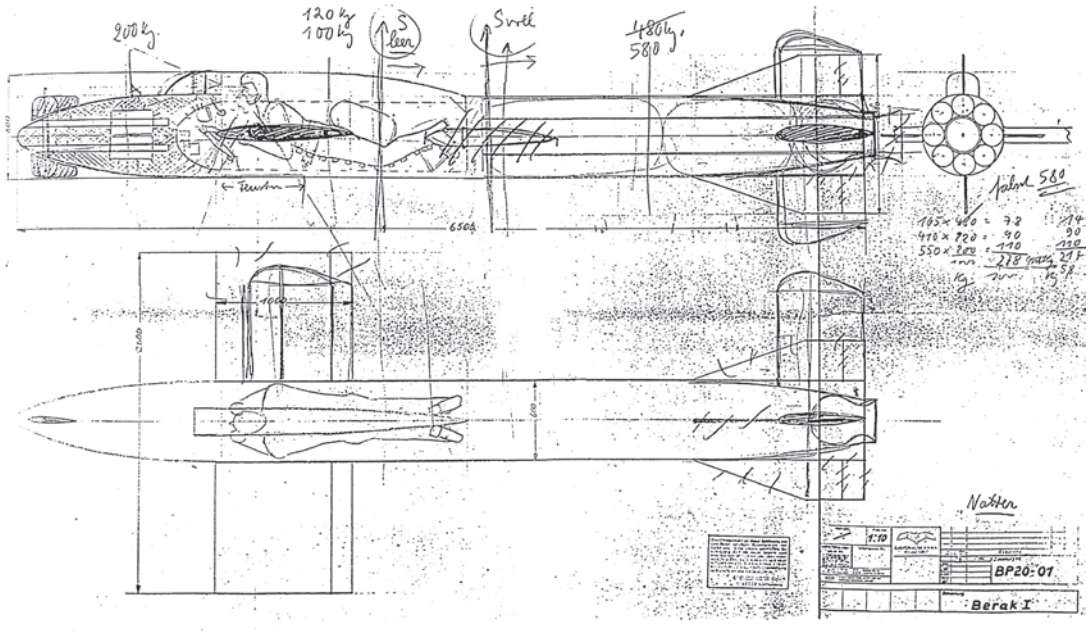
It seems Bachem first expressed on paper what was in his head on 16 July 1944, when he produced a crude sketch of a manned rocket with a single tube for firing a heavy-calibre projectile, or possibly a mortar, from its concrete nose, which could also be used to ram an enemy bomber if necessary. His sketch showed the craft with stubby, forward wings and rear vertical and horizontal stabilizers. The pilot lay prone and enclosed, but tilted upwards at an angle of 30 degrees to aid vision, behind an armoured windshield, and was to leave the aircraft using a parachute. Bachem subsequently refined his thoughts and produced a more detailed series of project proposal drawings the following month. These drawings are also believed to have been the first time the project was assigned the name '*Natter*' ('snake'). The Bachem factory gave *Natter* the official designation BP-20 (for *Bachem-Werk Projekt* 20), and the first drawing produced contained overlaid pencil marks and notes, indicative of speedy work, while by the fourth drawing the lower vertical tail fin had been removed, suggesting a plan for vertical take-off.

Maintaining the idea contained in the preliminary July sketch, the nose section, which housed the launch tubes for the foreseen rocket armament, as well as the sighting equipment, instrument mounting

# BACHEM BP-20 *NATTER* COCKPIT

1. Airspeed indicator (km/h)
2. Altimeter (km/h)
3. Turbine speed (expressed in U/min – rpm as percentage of nominal speed)
4. Turbine pressure (0–6kg/cm$^2$)
5. Combustion chamber pressure (0–25kg/cm$^2$)
6. Gyroscopic position indicator
7. Control column
8. Throttle lever
9. Seat





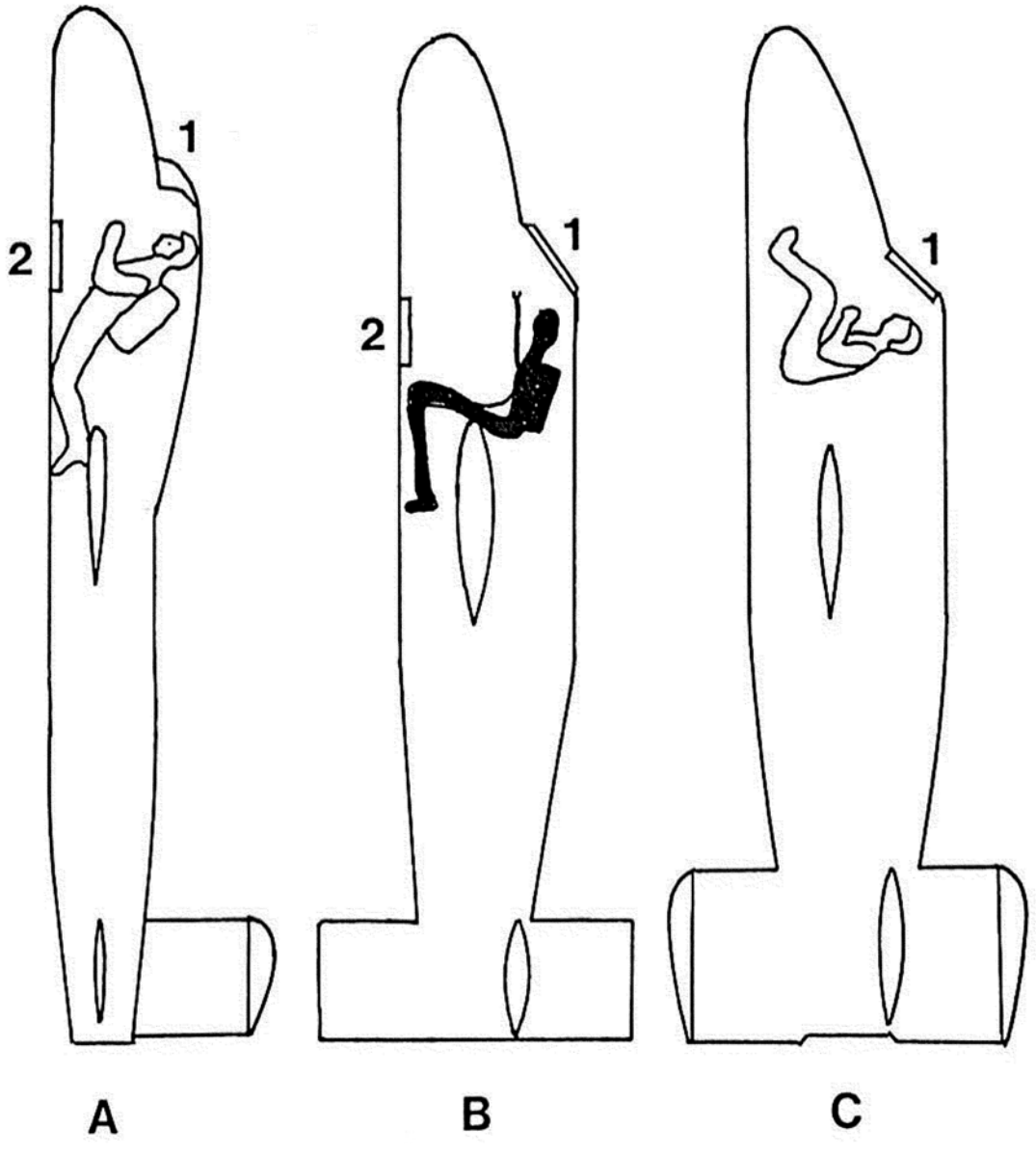

A refinement of Bachem's 16 July 1944 sketch, and probably produced after it. The design is now labelled 'BP-20', and this is drawing '01'. The pilot lies prone with a parachute, but looks through more of a cockpit-style glazing. The armament consists of a *'Rohr-batterie'* arrangement, using a circular battery of shells or projectiles installed in the nose.

and part of the steering system, would be cast in concrete, with the reinforcement rods used to strengthen the latter acting as bolts to connect the nose to the cockpit. The fuselage was made of plywood mounted around laminated circular frames.

In a specification issued on 9 August, the Bachem-Werk proposed an aircraft of 5.67m in length, with a wingspan of just 2.80m and total loaded weight (with pilot, equipment, propellant and munitions) of 1,230kg. The BP-20 would be able to reach a maximum altitude of 12,000m, with an ascent velocity of 650km/h when taking off vertically. Acceleration at take-off would be 1.6g, decreasing to 0.7g during ascent. Normal cruise velocity was rated at 800km/h, with a flight range of around two minutes and a range of operations of 16km at an altitude of 12,000m.

The pilot was to board the aircraft via a removable faired canopy and would be strapped into position. A clear viewing panel was located on the underside of the aircraft so that he could maintain sight of the horizon while in a vertical climb, and also for observing the ground during level flight. A rudimentary oxygen system and parachute were to be provided, which would be necessary in view of the planned maximum altitude. The pilot was to fly the *Natter* by the use of control columns in each hand. Pressing the columns forward effected an elevator-like control for diving or climbing, while pulling them back provided aileron-like control for rolling.

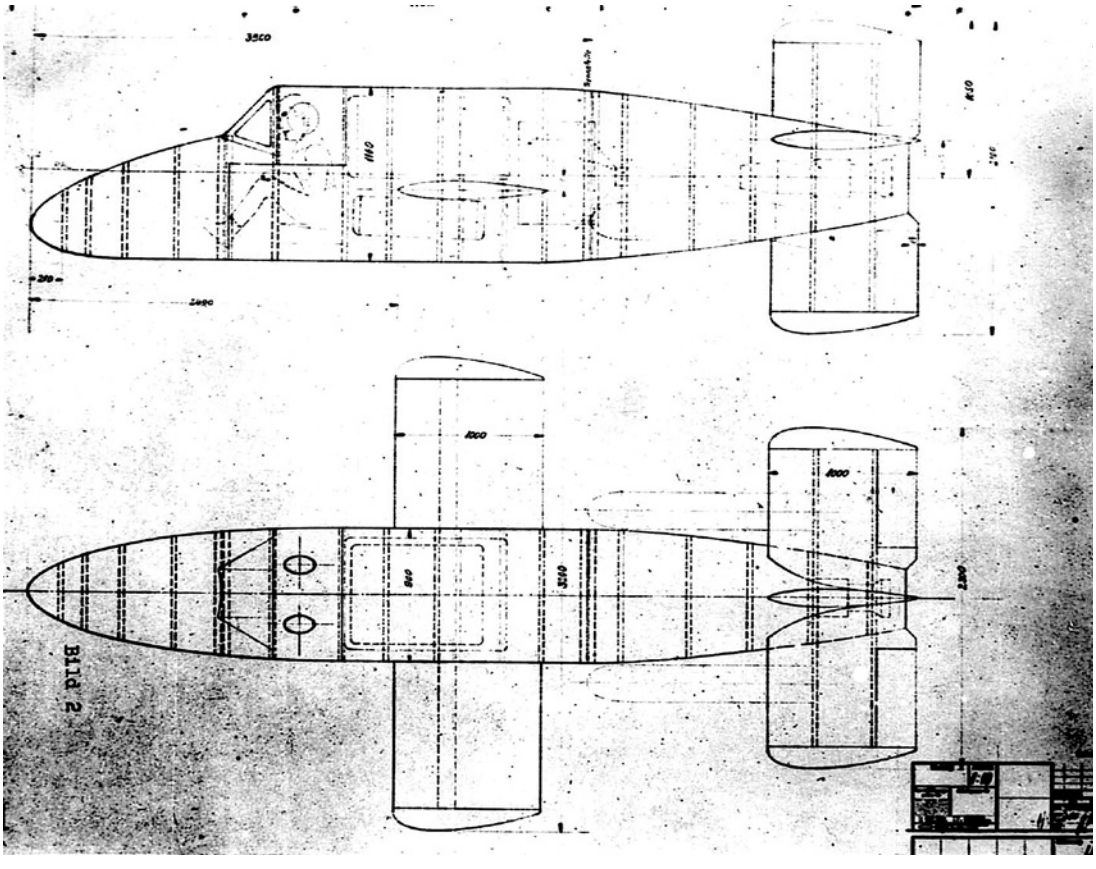
To accompany the drawings, Erich Bachem outlined in a concise manner how he saw the *Natter* being used operationally. Even at this late stage of the war, and in an outline of such brevity, he made a good case for further development:




The three variations of pilot position as considered by Bachem for his rocket interceptor – prone, crouched and seated.

'Annihilation of enemy aircraft, especially bombers, by bringing up a gunner within the immediate vicinity of the enemy and discharging rocket projectiles at him with the smallest possible amount of manoeuvring and propellant.

'No self-destruction of the pilot. On the contrary, he should have armoured protection. Smallest possible production cost, maximum use of wooden parts, reduction of iron. No burden on standard aircraft industry. Exploitation of large, partly underutilised, timber resources. Repeated use of the most critical airframe and propulsion unit parts by parachute recovery. Little flying requirement for the pilot due to the omission of a steered take-off, as well as omission of a normal landing.




The *Natter* emerges from the drawing board in this October 1944 schematic, drawing BP-20-09 showing a seated pilot enclosed in a cockpit. A cruciform tail arrangement has been incorporated, as have two externally mounted booster rockets.

Little ground input. Little transport cost. Easy transferability. Good camouflage potential.'

Tactically, the *Natter* was to be deployed once an enemy bomber formation was as close as possible to its launch site. In clear conditions, the interceptor was to pursue the bombers in a climbing curve and then shoot at least one down when within range. If conditions allowed it, a second attack could be attempted by descending towards other enemy aircraft flying further ahead, but at a lower altitude. Alternatively, more experienced pilots, if used, could climb into a loop and come in again from behind the same formation, although firm tactics still had to be agreed with whoever would fly the machine. 'Apart from this method of attack,' Bachem noted, 'numerous other variations are still possible, as well as variations in the kind of armament. In addition, of course, even the possibility of ramming exists.'

The notion of ramming enemy bombers as a measure of last resort may not have found approval with Erich Bachem, but the fact was that the pilots of the Luftwaffe's *Sturmstaffel* 1 had already committed to using their heavily armed and armoured Fw 190A-8s to ram B-17s and B-24s if necessary, and in the desperate fervour cooked up by the Nazis at this stage of the war, such reckless bravado was favoured in some quarters.

However, there was one aspect of his design that continued to worry Bachem – the effect of the accelerative force to which a pilot's body would be subjected during the *Natter*'s full-power vertical climb. This would adversely affect a pilot's general, physical and psychological capabilities, restrict his mobility and limit his ability to think and to make decisions. The increasing positive g-force applicable at take-off would serve to hinder the return of blood from the abdomen and legs to the heart, thus reducing blood flow to the brain. This issue forced Bachem to re-look at how the pilot was accommodated inside the BP-20 and it is believed at one stage his team considered a kneeling position whereby the pilot's back was against the roof and his knees on the cockpit floor. Eventually, the design was changed so that the pilot could be seated. This development was aided by the inclusion of an autopilot which could be used to guide the craft to its operational height. Thus the pilot only needed to be able to look ahead through his windshield as he made his attack, and in turn it meant the underside window could be removed.

At launch, with the *Natter* sitting on the ground vertically, the pilot would be cradled on his back with his upper legs at 90 degrees so that the g-load resulting from the acceleration during lift-off would be taken by the more tolerated transverse direction across his chest to his back. A further drawing of the BP-20 dated 7 October 1944 showed a significantly changed design, incorporating a seated pilot, the return of a lower vertical tail fin and the fitting of booster rockets on either side of the rear fuselage. Furthermore, in order to carry some of the latest weapons and firing systems under development by German engineers and ballistics specialists, the concrete nose was replaced by a simple wooden monocoque design. The *Natter* was now formed of three basic elements – the nose section with weapons housing, the centre-section of the fuselage with wings, two propellant tanks and the forward part of the Walter rocket motor and, lastly, the rear fuselage with combustion chamber and tail unit.

Despite the removal of the concrete, the weight of this revised design increased to 1,480kg, attributable to the new cruciform tail and the inclusion of two MK 108 cannon each with 30 high-explosive rounds. As mentioned, this all necessitated the addition of two Schmidding SR (possibly for '*Startrakete*') 34 booster rockets, each weighing 115kg and each with a thrust of 1,000kg and burn duration of 12 seconds.

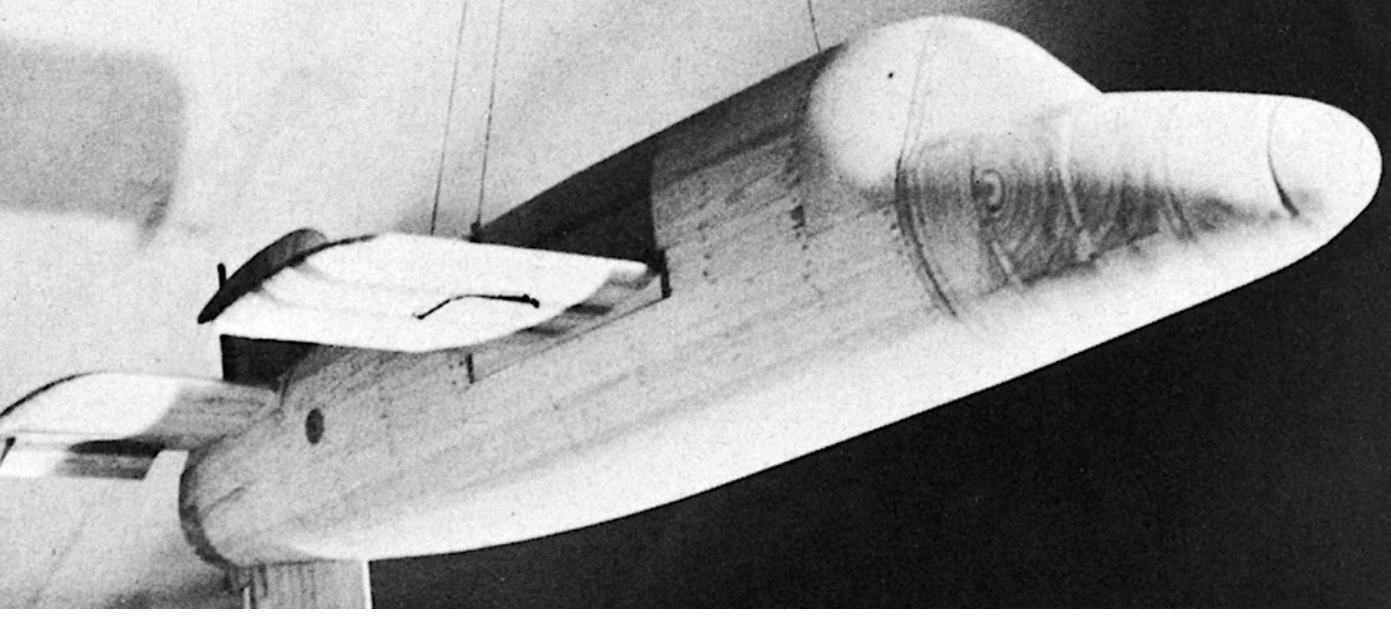
The new design relied, essentially, on the same method of employment. At an altitude of 1,200m and a speed of 885km/h, the spent boosters would detach automatically and the main HWK 509 C-1 rocket engine would fire up. Fifty seconds later, the *Natter* would be at the same height as the bombers. The autopilot would be switched off, then the pilot would manoeuvre his craft into the attack and at a range of 300m he would fire his weapons. After completion of his attack and during his descent, the pilot would then detach the nose section and he would be catapulted away by the sudden deceleration, resorting to his parachute. The fuselage, less the nose, would then fall to earth under its own parachute and await recovery.

As Bachem noted after the war, 'In a few weeks the "*Natter*" gained shape. From a winged rocket grew a cross between rocket, aircraft and anti-aircraft projectile.' By September 1944, however, there was a risk that Bachem's proposals would be rejected by a sceptical RLM in favour of the He P 1077 *Julia I*. Though, ostensibly, the *Natter* was dismissed on both technical and tactical grounds, it is fair to say that Bachem was still at an initial stage of design. But the RLM had not reckoned on Erich Bachem's self-belief or his determination. In his view, what could not be achieved through the RLM could be achieved through the SS.

At a venue in southern Germany during the late summer or early autumn of 1944, Bachem secured an appointment with SS-*Obergruppenführer* Hans Jüttner, the *Chef des* SS-*Führungshauptamtes* (Chief of the SS Command Main Office) responsible for the general administration of the *Waffen*-SS, and SS-*Sturmbannführer* Otto Skorzeny, the notorious, scar-faced *Waffen*-SS 'commando'. Bachem was swimming in potentially dangerous waters, but through the offices of Jüttner and Skorzeny, he was, apparently, able to secure an appointment in Berlin with the *Reichsführer*-SS, Heinrich Himmler, one of the most powerful men in the Third Reich. The historical record on whether this meeting ever actually took place is sketchy and ill-documented, but it seems that SS interest in the *Natter*, at a time when Himmler was overtly expanding SS involvement in German armaments, did work in Bachem's favour and Himmler did lend his backing.

One of Bachem's handicaps was a lack of skilled labour needed to produce the *Natter* in numbers and, if nothing else, Himmler assured Bachem that this problem would be resolved by a supply of 'disabled men who are skilled mechanics'. Indeed, the *Waffen*-SS viewed the little BP-20 not only as a target-defence interceptor, but as a 'war-deciding device', while on Himmler's instructions the SS-*Führungshauptamt* ordered that 'all agencies and offices' had to support it.

With the SS clearly in the frame, *Reichsmarschall* Hermann Göring, whose prestige as commander-in-chief of the Luftwaffe was at an all-time low as a result of his seeming inability to counter the Allied bombing offensive, and the RLM had to be seen to cooperate. In mid-September, the RLM reluctantly awarded the Bachem-Werk a contract for 15 BP-20s, while Himmler also kept his promise and despatched SS-Obersturmführers Heinz Flessner and Gerhard Schaller to Waldsee, along with a team of 120 workers. Dipl.-Ing. Flessner was in command of the construction and work detachment, known as the *Waffen*-SS *Sonderkommando Waldsee*, while Schaller, an engineer who had previously been involved in research into high-altitude aviation, was to act in a liaison capacity with the RLM and to monitor production processes. Most of the *Sonderkommando* comprised wounded and invalided SS soldiers with some engineering backgrounds, but they were not regarded as combat troops, having no weapons. In addition to this resource, some forced labour was also drawn in to the Bachem-Werk. Bachem was encouraged by the SS support, and noted that this meant his project could move ahead at 'full speed all along the line.'



CHAPTER THREE

# LAUNCH

Work on the *Natter* commenced in earnest in September 1944, and by 4 October the first prototype, the V1, later referred to as BM1 (*Baumuster* [construction type] 1), was completed within a fortnight of Bachem being awarded the RLM contract. To ensure communications ran as smoothly as possible with the RLM for subsequent production, the Bachem-Werk requested an official ministry designation for its aircraft, and it was assigned the RLM number '349' on 28 October. Thus, in documentation, the *Natter* was duly referred to as the 'Ba 349', although factory personnel still called it the BP-20.

Wind tunnel testing is believed to have been carried out in September using a 1:2.5-scale wooden model subjected to a velocity of 500km/h at the *Deutsche Versuchsanstalt für Luftfahrt* (DVL – the German Test Establishment for Aviation) at Berlin-Adlershof. The model was made so that tests could be carried out with and without a nose cap, with four different wingspans, with and without the tailplane and with three different tail fin spans. Curiously, it seems the Bachem-Werk was never advised of the results of the DVL tests, although staff were informed, briefly, that the *Natter* should retain satisfactory flying qualities at speeds up to 1,100km/h.

The following month, investigative work was also undertaken at the Peenemünde research establishment into provision for an automatic guidance control system for the *Natter*. Perhaps not surprisingly given the location of the research, the system proposed was the LEV-3 as used in the A4/V2 rocket being fired at London. The plan was for gyroscopes and a timer to activate once the *Natter*'s rocket motor was fired and the aircraft had launched. The pre-programmed elevator

A wooden wind tunnel model of the BP-20, possibly photographed at the *Deutsche Versuchsanstalt für Luftfahrt* at Berlin-Adlershof during tests in September 1944 that investigated variations in wingspan, as well as nose and tail configurations. These indicated that the design was able to fly at speeds of up to 1,100km/h.

control would activate ten seconds later, by which point the *Natter* would have reached an altitude of 1,000m. It would then be guided into a pre-determined angle of climb towards enemy bombers. Upon reaching their altitude, the *Natter* took a horizontal path by further deployment of the elevators. At this point, the guidance system disengaged and control was passed to the pilot, who would handle the aircraft during the attack.

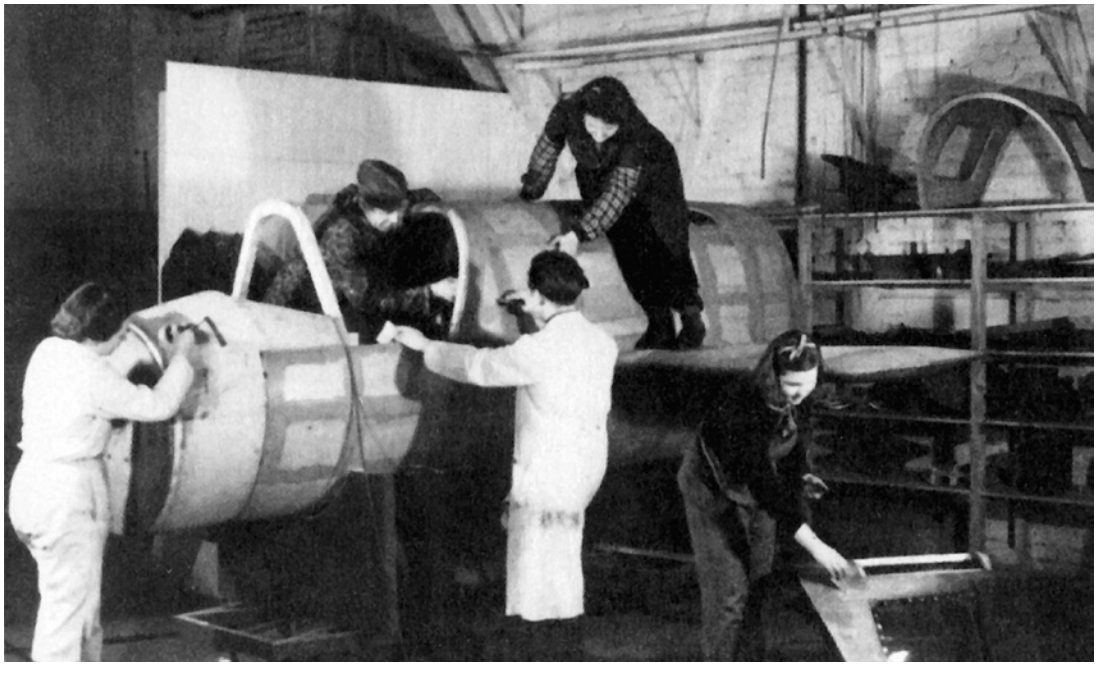
It seems the technicians at Bachem preferred the K23 fighter autopilot over the LEV-3, the former, built by LGW at Hakenfelde, near Berlin, being assembled in under 40 man-hours.

Amidst a sense of prevailing antipathy from the RLM towards Erich Bachem's design, the envisaged appearance of the formidable B-29 Superfortress four-engined bomber that it was believed would replace the USAAF's B-17 Flying Fortress during 1945 served to inject a significant revision in mindset. Since 1942, the B-17, together with the B-24 Liberator, had carried out the USAAF's daylight bombing campaign of the Third Reich and its occupied territories. With its formidable defensive armament, the Flying Fortress had proved a tough adversary. But the B-29, which had a greater bomb-load capacity than the B-17, would raise the stakes even higher.

The level of apprehension regarding the arrival of the Superfortress can be seen in a report from a Luftwaffe intelligence officer at the daily OKL situation conference on 31 March 1945, which stated that 'in the last attack on Berlin, ten American four-engined B-29s were seen for the first time, flying at an altitude of 9,500m. The appearance of this American high-altitude and long-range bomber in Europe would mean that the present four-engined types are already going out of production and are being replaced only by the B-29. Intelligence is assigned the duty of further investigating the matter with the means of reconnaissance at its disposal.' In fact, there were no operational B-29s in Europe. Nevertheless, this did not prevent the concern that the appearance of Allied jet fighters and B-29s was an imminent prospect.

Thus, in October 1944, a first series batch of 50 *Natter*s was ordered for delivery up to January 1945, and thereafter, once that batch had been built, it was planned to order 200 more. It was hoped that these would offer some defence against the B-29. In order to facilitate the production of such numbers, SS-Obersturmführer Flessner ensured that whatever the Bachem-Werk needed, it got. To this end, he sent out his men into the neighbouring towns, villages and farms around Waldsee to procure timber and any other tools and items that might be useful, with force, if necessary.

The main material needed for the construction of the airframe was pine and spruce, with individual components being made in small, sub-contracted workshops across the Reich. Given his long friendship with Wolf Hirth, it is perhaps not surprising that the Flugzeugbau Wolf Hirth at Nabern/Teck was engaged to build the BP-20. After the war, Hirth told Allied interrogators that his factory had been contracted to build ten *Natter* airframes, but these had only been partially completed by the time Germany surrendered.

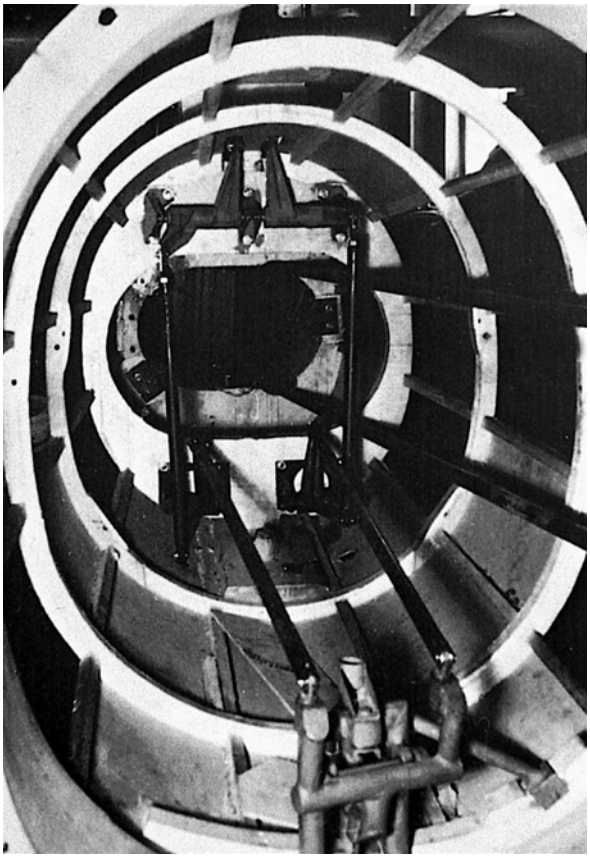


A mixed-sex workforce was employed at the Bachem-Werk. Here, the frame glue joins in the forward section of a BP-20's wooden fuselage are checked and sanded down. The worker in the cockpit gives a good sense of how confined space was.

Such resourcing meant that there was no adverse effect on the wider needs of the aircraft industry. According to Erich Bachem, only 600 man-hours were required to build one airframe, excluding production and fitting of the Walter rocket motor, although compared to a larger and more complex Jumo or BMW jet engine, the Walter was simpler. Furthermore, the manufacturing process used by the Bachem-Werk, at least for initial production, was one that did not require the use of gluing presses, but rather the hand-application of Kaurit WHK, a synthetic-resin glue developed during the 1930s of the urea-formaldehyde-resin or amino-aldehyde-resin type. Developed by Dr Hanns Klemm, and sometimes referred to as 'Klemm glue', Kaurit WHK was utilized in glider construction. To 'Kaurit W' was added a Bakelite powder filler to inhibit the crystallization of the glue. The glue was 80 per cent Kaurit W and 20 per cent Bakelite powder. In addition, for reinforcement, 25mm nails were to be used to build the *Natter*.

The fuselage of the early BP-20/Ba 349 was formed around 19 pine wood frames – five in the nose, eight in the centre section and six in the rear, each with a cross-section of 30mm x 40mm, except those at the dismantling points where the fuselage connected to the wing spars. Here, the frames had added plywood strips which increased their thickness to 40mm x 50mm. During construction of the fuselage, the frames were mounted in an assembly jig.

To eliminate timber wastage during series production, hoops and half-frames would be rolled continuously from 5mm veneered laminated battens. Half-sections would be joined, or 'scarfed', by overlapping longitudinally and gluing them, and thus lengthening them. The scarfing presses, which applied heat and pressure to a join, were made by the factory and the resulting joins were as strong as the



View through the centre fuselage section looking towards the rear of the aircraft. This photograph illustrates the framework construction and the control rods for the elevons. These were intended for use with an auto-pilot system. Into this space would be mounted the Walter rocket motor and, roughly where the photographer is positioned, the propellant tanks.

wood from which they were made. The frames were joined together by approximately 20 longitudinal stringers of cut pine wood with a 20mm square cross-section. The stringers were glued into slots cut into the outer edge of each frame. These slots were sufficiently deep so that the stringers were flush with the edge of the frame. It was planned to reduce the number of stringers to 12.

The nose and rear sections were then covered in 2mm plywood sheets, while the centre section was clad in 3mm-thick sheets. The plywood was glued and nailed to the frames at 25mm intervals. The first step in the fuselage construction process, however, was to clad the underside of the fuselage so that the main wings and tail section could be attached. The fuselage was designed to take acceleration of 6g at a velocity of 1,100km/h at 3,000m with a safety factor of 1.5. For longer-term series production, the RLM planned to introduce the somewhat desperate measure of replacing the plywood sheets with 4–5mm-thick cardboard in order to save on wood.

Internally, the *Natter*'s Walter HWK 509 rocket engine was housed in a box framework in the centre of the fuselage main section, with the thrust tube, 'lantern' and combustion chamber running to the rear of the aircraft. The engine drew its fuel from two aluminium tanks, one for T-*Stoff*, which was semi-circular in cross-section and holding 365 litres, and a second, smaller tank, rectangular in cross-section, of 165 litres capacity for C-*Stoff* (see tint box on page 28). These were located in the forward part of the centre section between the rocket motor and the armour bulkhead immediately behind the pilot's seat. An RLM engineer, *Flieger-Stabsingenieur* Egon Magerstädt, who carried out a technical review of the early *Natter*, asked the Bachem-Werk to incorporate a minimum number of pipe joints so as to avoid propellant vapours leaking from them – something that Me 163 pilots had been subjected to, resulting in severe irritation to eyes and nose and, on occasion, loss of consciousness.

In the cockpit, the pilot's plywood seat was of relatively crude form since, in reality, it was little more than a support for the seat parachute. The pilot would look out through a steel-frame windshield that had a central, rectangular-shaped, 60mm-thick, armoured glass panel flanked by two triangular, 10mm-thick side Plexiglas panels. The windshield frame was screwed into the fuselage at the rear of the nose section. The canopy, like most of the aircraft, was also made of plywood on a laminated pine or spruce framework.

The pilot controlled the *Natter* via a control column formed of a length of steel tubing, 30mm in diameter, mounted in two brackets

# THE HELLMUTH WALTER KOMMANDITGESELLSCHAFT HWK 109-509 ROCKET ENGINE

From a tactical point of view, the Bachem Ba 349 *Natter* needed a low-weight, low-cost, high-thrust rocket motor to enable it to reach the altitude of an incoming bomber formation much faster than a conventional fighter. In reality, there was little manufacturer competition, and the *Natter* would be powered by the HWK 109-509 rocket engine designed and built by the Hellmuth Walter Kommanditgesellschaft in Kiel, founded by Professor Hellmuth Walter (born in Wedel, near Hamburg, on 26 August 1900), in July 1935 and known more simply as the Walter-Werke. Though principally a marine engineer, Hellmuth Walter had led the field in the area of peroxide motors as used in take-off assistance rocket units for aircraft, as well as in airborne missiles and torpedoes.

Walter developed engines powered by hydrogen peroxide, an oxygen-rich fuel capable of generating power by combustion without the need for atmospheric air. The chemical breakdown of hydrogen peroxide produced oxygen, heat and a large increase in volume, creating a mass flow of gas with sufficient power for an engine. Walter's early work centred on using hydrogen peroxide for submarine turbines and torpedoes. In 1936, he began developing liquid-propellant rockets for rocket-assisted take-off (RATO) for aircraft (used extensively by the Luftwaffe) as well as aircraft engines using C-*Stoff* (known as 'cold' start) and C-*Stoff*/T-*Stoff* (known as 'hot' start).

The HWK RII 203 'cold' engine, designated by the RLM as 109-509A, was used to power the early Me 163A rocket fighters and was fuelled by T-*Stoff*, an aqueous solution of concentrated hydrogen peroxide, and Z-*Stoff*, a concentrated solution of sodium or calcium permanganate that was used as a catalyst. The Me 163B was fitted with the 'hot' HWK RII 211, designated by the RLM as 109-509B, which was fuelled by C-*Stoff*, a mixture of hydrazine hydrate, methanol and water, and T-*Stoff*. These were highly volatile chemicals, and the Me 163 pilots and groundcrews of JG 400 had to handle them with extreme care, since an inadvertent mixing of the two propellants resulted in spontaneous ignition, with catastrophic effects and the burning of any organic matter such as clothing or human flesh.

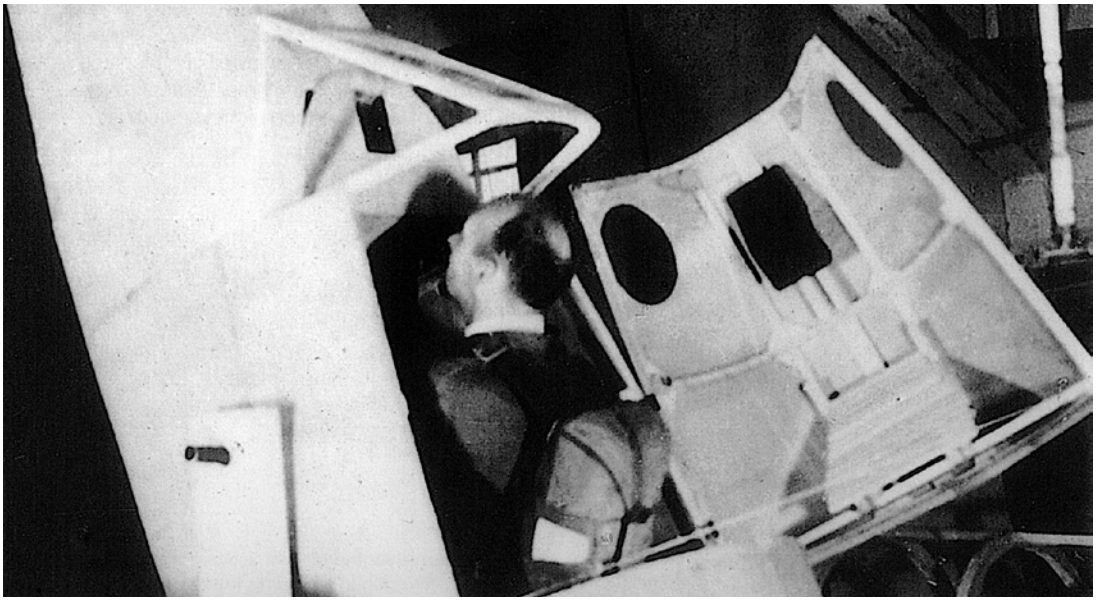
The rocket motor decomposed T-*Stoff* in a reaction with a catalyst to produce a large amount of thrust. The decomposition of the peroxide produced an exhaust gas flow, rich in oxygen. This enabled the fuel to burn in a combustion chamber so as to boost thrust. The RII-211 motor used T-*Stoff* as the oxidant and a second propellant that combined a copper salt catalyst for the decomposition of the peroxide, and a hydrocarbon fuel and ignition promoter.

The single-stage fuel pump had an additional helical screw stage to draw fuel from the tanks. As the main pump was a centrifugal type (which could lack suction power), the helical screws boosted the suction for bringing fluids the distance from the tanks to the motor. The single, turbine-driven pump was divided into two halves, running on a common shaft, one half for each fuel. The whole pump was controlled indirectly via a system to regulate the generation of steam driving the turbine. The flow of propellant to the combustion chamber was controlled by the pilot using his throttle. A mechanical regulator ensured that the ratio of fuel to oxidant was correct at all power settings.

At an early stage of the *Natter*'s development, it had been decided to use a modification of the HWK 109-509A-2, as developed for the Me 163B, which was designated the 109-509A-2E. Developing 1,500–1,700kg of thrust and weighing 160kg, this motor incorporated some rearranged parts, including the T-*Stoff* start-up system and steam generator, to allow for correct functioning during a vertical take-off (VTO) procedure in which, with the motor in the vertical position, the gravity starting tank would be lying in the same horizontal plane as the steam generator. This meant that the flow of T-*Stoff* would not occur, as well as the possibility of having to restart the motor while in horizontal flight. Thus, the gravity starting tank was moved in front of the engine mounting frame. Tests with the HWK 109-509A-2 commenced in the autumn of 1944, but delays meant that neither this, nor an E sub-variant, ever saw production.

Progressively, Walter worked on increasing fuel flow rates on the A-2, which resulted in a maximum thrust of 2,000kg and a minimum of 250kg.

**The Walter HWK 109-509 rocket motor looking along the vent pipe to the combustion chamber at the rear. This example is fitted to a mobile test stand prior to installation into an Me 163 rocket interceptor.**



A Bachem technician sits in the mock-up of a *Natter* cockpit during tests to assess the optimum position for a pilot. Note to the left what appears to be part of a mechanism to allow the mock-up to tilt. The photograph illustrates the intended available space in the cockpit for a pilot and his parachute, as well as the design of the hinged canopy hood with, at this stage, its small vision panels.

welded to the forward end of a torque tube. Elevon control was effected by an integrating unit mounted on frame 13 that took the form of a 30mm-diameter x 1.5mm-thick steel tube, and cut and bent pieces of steel plate. This integrated all possible movements of the control column in order to produce the appropriate deflections of the elevons on the tailplane. Forward and back movement produced symmetrical deflections of the elevons for pitching and climbing, whereas side-to-side movement resulted in reciprocal deflections for rolling.

Because of the restricted space in the cockpit, foot pedals for rudder control in the early BP-20 were hinged on a tube just in front of the nose armour-plated panel bulkhead, into which were cut two holes that the pilot would extend his legs through. The pedals were again wooden, and it was planned that they would separate with the nose section at the moment the pilot left the aircraft. In order that he could safely leave the aircraft following his mission, the pilot would pull down on a lever mounted on the right-hand wall close to the bottom of the armour plate of the dividing wall with the nose. Pulling downwards and anti-clockwise would activate linking rods that would pull out locking plates simultaneously from four pintles, which were bolted into the rear bulkhead of the nose and which ran through into corresponding sockets in the forward bulkhead of the centre section. Once pulled, the nose was free to separate from the centre section under aerodynamic forces.

Side to side movement of the control column rotated the torque tube on whose rear end a short vertical lever was attached. A short length of solid steel rod transferred the motion of the end of this lever to one arm of a bell crank mounted to the right of the centre line on frame 8. The other arm of the bell crank was connected to a control rod that passed back to the region of frame 13. Forward and backward movement of the control column operated a push rod which passed through the centre of the torque tube and continued directly back to frame 1.

A Bachem worker planes the wing frame for a BP-20.

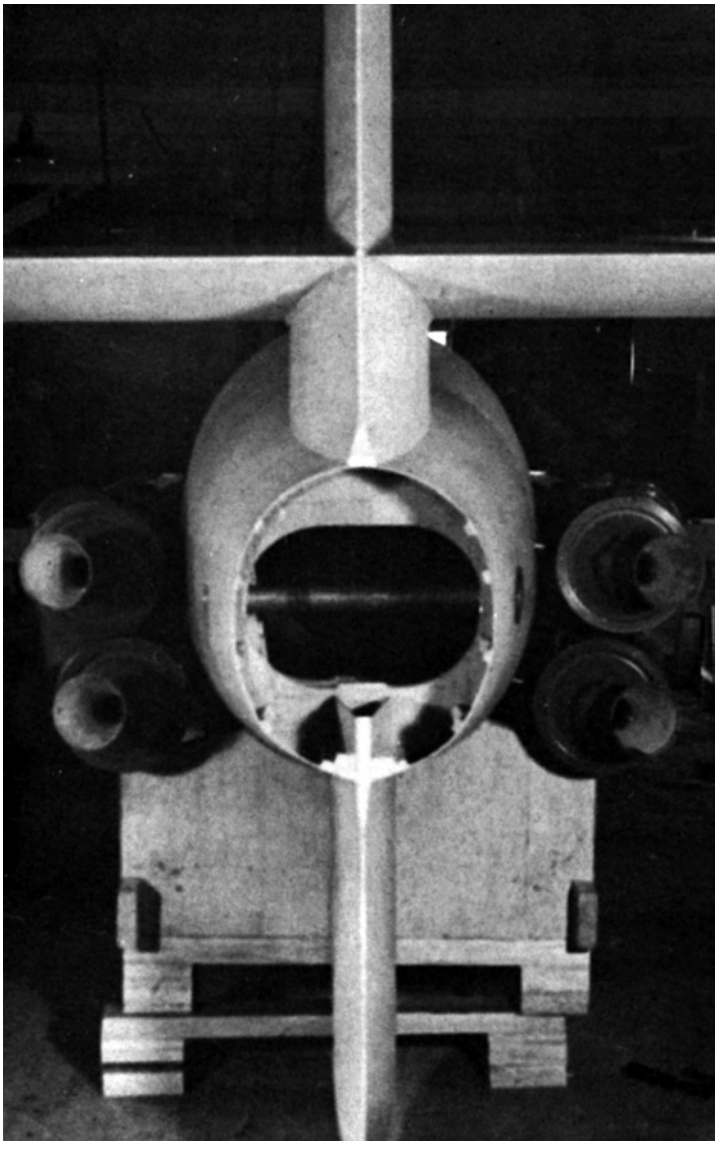
Each wing was assembled as a unit and was rectangular in shape, the cross-section profile being constant along the whole length of the aircraft's wingspan, while the main spar, made up from four pine girders, also ran almost the whole length, but did not extend into the wingtip caps. The pine girders were built up from four 25mm square laminated timbers and a central timber, 20mm x 25mm. They were not solid throughout, but were lightened at their extremities. An elongated 'V' was cut into the end of each girder, into which four strengthening wedges were glued at equal distances. The four girders were not glued together and were separated by 3mm plywood coverings. The wings were covered with 3mm beech plywood panels that were glued and nailed to the wing framework. The wing spars were glued to the nearest frames in the fuselage (9, 10 and 11) and secured further by bolts.

The cruciform tail section was constructed in essentially the same way as the wing section, but with the addition of elevons in the tailplane and rudders in the upper and lower vertical fins. Like the wing, the tailplane also had main and auxiliary spars, and in the early prototype BP-20s, the spars would run through the upper rear fuselage, above the rocket motor, and were then glued to frames 17 and 18 and fixed with screws.

Externally, on the early *Natter* design, a jettisonable rocket booster unit was mounted on each side of the rear fuselage.

When complete, the *Natter*'s fuselage measured 5.85m in length, with a width of 0.64m, and its wingspan ran to 3.62m. Various cannon and rocket armament configurations were considered, and these will be covered in Chapter 4.

So much for the initial design of the aircraft. However, as early as the beginning of October 1944, Bachem's designers and engineers were contemplating enhancing the *Natter* to make it a truly fit-for-purpose operational machine. A drawing of 3 October shows a revised design with a shorter, asymmetrical lower vertical tail fin, with its leading edge angled up at around 45 degrees to the underside of the fuselage. This change would become a common feature in all subsequent design revisions, and was most likely incorporated to take into account launching the *Natter* from a necessarily simplified field launch structure. Additionally, the aircraft was shown with four external rocket booster units, the nozzles of which were directed away from the longitudinal axis of the units so that their thrust blast was aligned with the aircraft's centre of gravity to ensure stable flight.

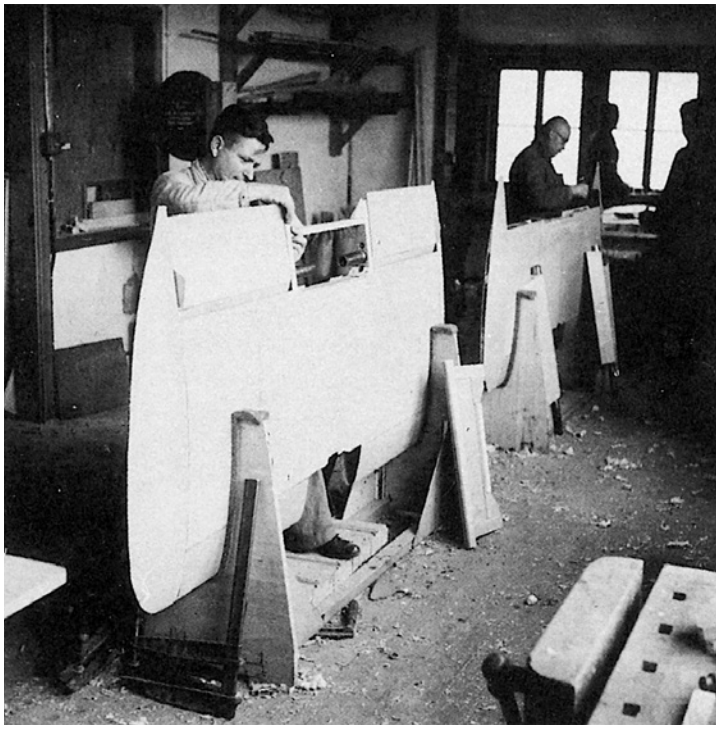


Rear view of a *Natter*'s cruciform tail assembly showing four externally mounted Schmidding SG 34 booster rockets and nozzles. In this model, the horizontal stabilizers have been integrated into the vertical fin and are separated from the fuselage, which is how it would have been made for VTO trials.

The design was re-worked throughout November 1944, resulting in a report issued on the 27th in which three variants of the BP-20 – A, B and C – all with four boosters, were proposed. Each variant was capable of reaching an operational altitude of 12,000m. Climbing at an angle of 60 degrees, the BP-20 A, weighing 2,050kg at take-off and carrying 600kg of propellant, would be able to attain that altitude in 62 seconds. At 12,000m, it had a combat range of 55km and an operational endurance of just 1.7 minutes. Comparatively, the BP-20 B, weighing 150kg more at 2,200kg as a result of larger capacity tanks with 750kg of propellant, would take another eight seconds to reach 12,000m, but its combat range extended to 81km and endurance to 3.1 minutes.

There was a proposal to launch the B version by means of a 20m-long catapult and the fitting of a Walter rocket motor with thrust of 2,000kg. The catapult would provide acceleration of 7g for about three-quarters of a second, with terminal velocity of 52m per second (189km/h) – about half the rate of acceleration and velocity of the V1 flying bomb at launch. It was estimated that when fitted with four boosters each set for 1,200kg thrust at ten seconds burn time and a main liquid propulsion thrust of 1,700kg, a maximum altitude of 19,000m could be attained, with a maximum range of 58.5km at 15,000m. With four smaller rockets fitted of 1,000kg thrust at six seconds burn time, maximum altitude would be 13,100m, with a dramatically reduced maximum range of 15km at 12,000m.

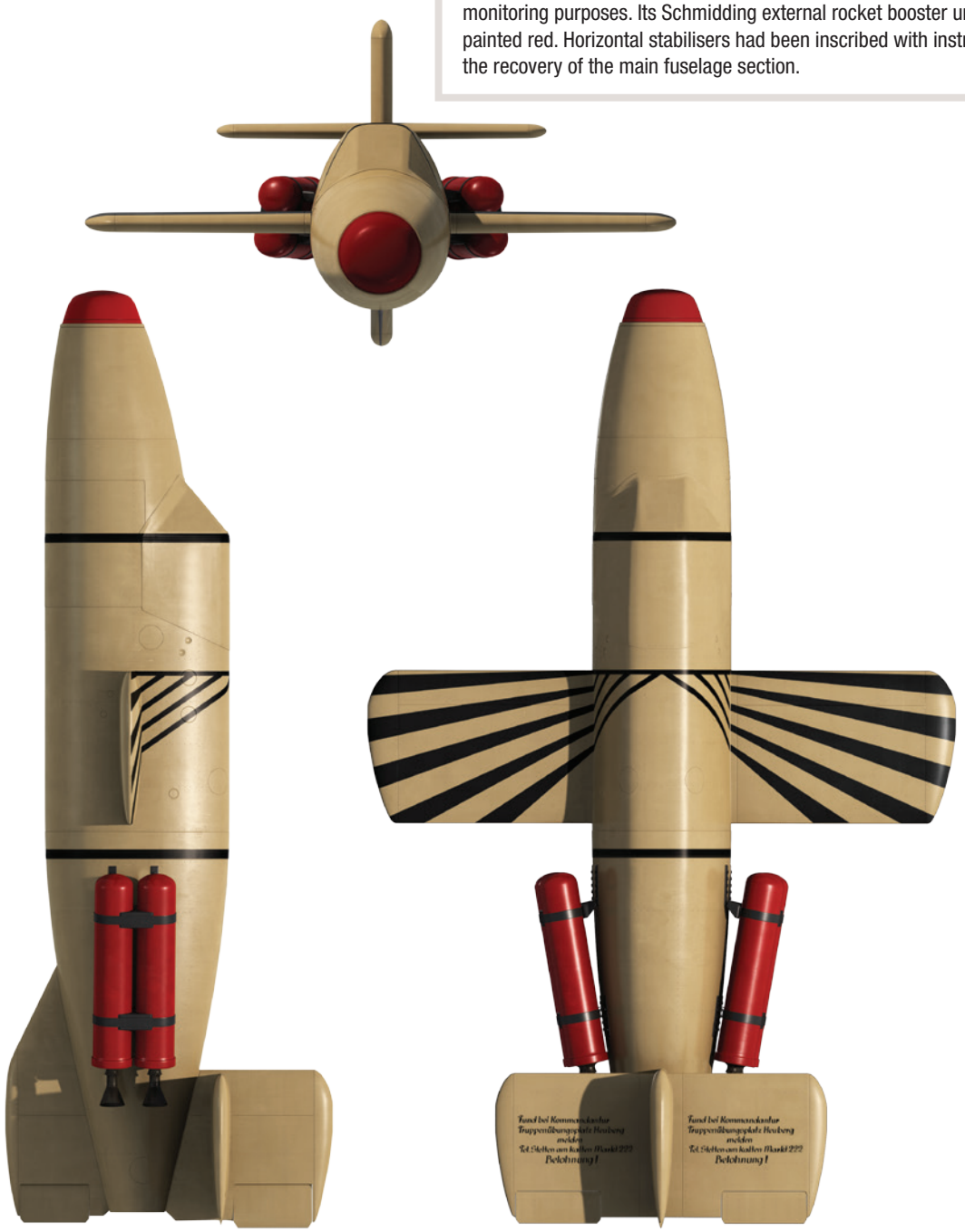
In the closing weeks of the war, German air-medical experts did undertake some research into the human body's ability to withstand



Joiners work on the horizontal stabilizers. The metal control rods are visible for the elevators. Note the confined space of the workshop.

## BACHEM BP-20 M17 PROTOTYPE (unmanned experimental craft)

This aircraft was finished in what closely resembled an overall RLM 04. Wings and central fuselage carried an asymmetrical 'sun ray' finish for monitoring purposes. Its Schmidding external rocket booster units were painted red. Horizontal stabilisers had been inscribed with instructions for the recovery of the main fuselage section.

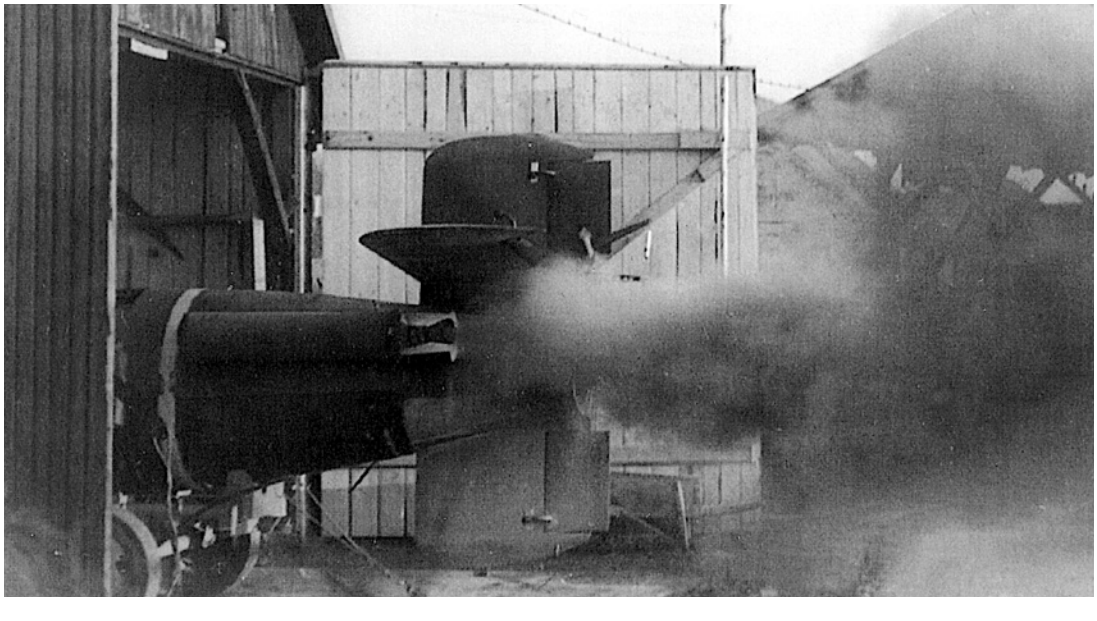


such a launch, but hostilities ended before any finite conclusions could be reached.

Finally, the BP-20 C, at 2,050kg, seemed to have no discernible advantage over the A, and it may have been conceived for calculation purposes only, although some sources refer to it having the wing section mounted further aft and separable from the fuselage for easier transport.

The boosters were of the Schmidding SG 34 (109-533) solid-fuel type manufactured by the Schmidding-Werke at Tetschen-Bodenbach in the Sudetenland. As already mentioned, early drawings and specifications of the *Natter* show installation of the Schmidding SR 34, but certainly from December 1944, the boosters are referred to with the prefix 'SG', which is believed to stand for either '*Schmidding Gerät*' (Schmidding device) or '*Start-Hilfe Gerät*' (take-off assistance device). Basically the same in design, construction and weight as the SR 34, the SG 34 had a marginally increased thrust of 1,200kg, although burn duration was only ten seconds. Each unit was 118cm in length, excluding the exhaust nozzle, with a diameter of 25.5cm, and was fastened to the fuselage of the *Natter* at three attachment points. It is believed that the boosters were released after their fuel had been burnt by the automatic shearing of explosive bolts. Without the boosters (or a catapult), the *Natter* would have been able to reach a maximum operational altitude of only 6,000m, with a range of 14.5km.

After completion of the first prototype BP-20, initially known as the V1, the designation for this and successive prototype machines was changed to 'BM1' for *Baumuster* (construction type) 1, etc. However, the '*Bau*' element of this designation was also subsequently dropped, and all early examples were referred to simply as 'M1', 'M2', etc. At some point in the autumn of 1944, the initial order for 15 *Natter* prototypes was increased to 50, presumably as a knee-jerk response to the growing need to protect the Reich's factories – something which the Luftwaffe's



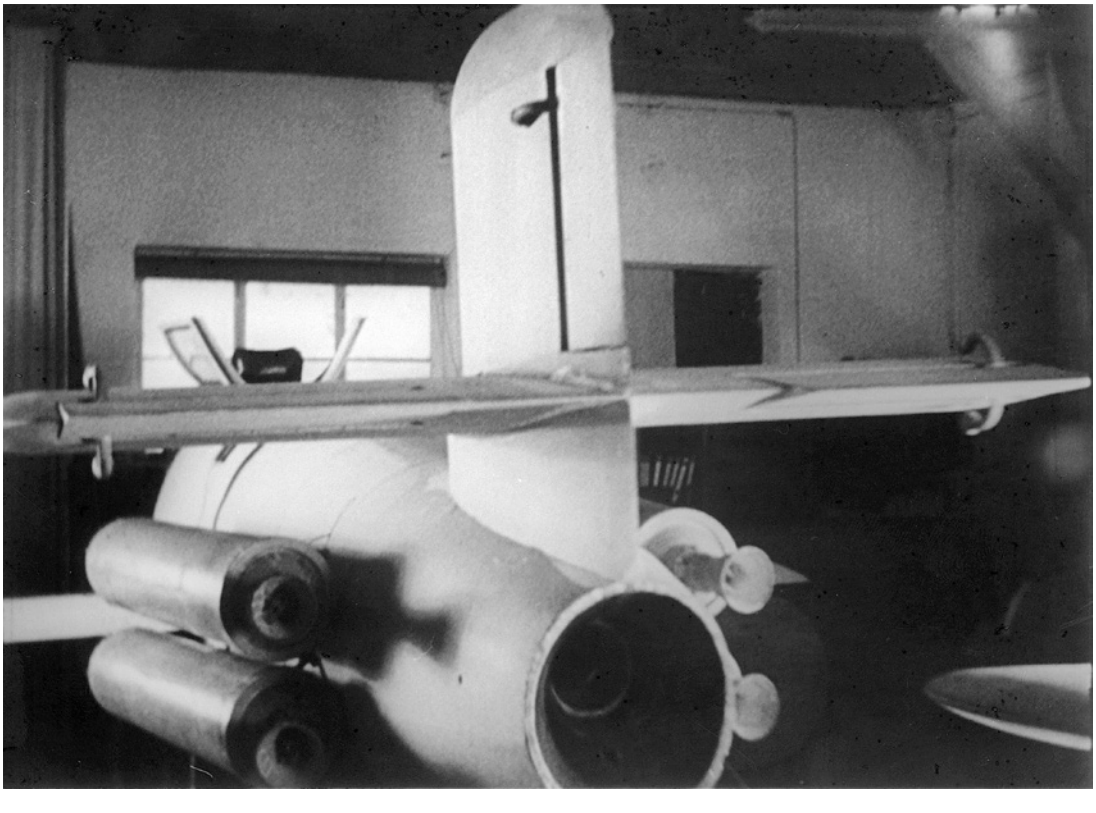
Testing of the two Schmidding SG 34 booster rockets on an early *Natter* that has been tethered to a cart in a shed at the Bachem-Werk. A curved metal shield offers the wooden fuselage some protection from the flame jetted out by the rocket.

conventional fighter units seemed ill-equipped to do. In a series of unmanned tests, it was planned that the first ten aircraft, M1 to M10, would be assigned to test gliding characteristics, while M11 to M20 would be used to assess VTO. The series M21 to M30 would be used to assess the efficiency – or otherwise – of pilot and aircraft recovery by parachute. The machines M31 to M40 would be launched fitted with the planned K23 fighter autopilot system, and M41 to M50 would end the 50-aircraft test programme by evaluating all of these elements.

All 'M' types would be fitted with four SG 34 booster units and launched from a tall, steel-frame tower designed to guide the *Natter* until it reached sufficient speed for stable flight. *Natter* M51 would be the first machine to fly with a pilot making a VTO. However, by late November 1944, production of the 'M' series had fallen behind and construction was extended to last until the end of January 1945.

In December 1944 the first drawing emerged of the Ba 349A-1 operational *Natter*, which incorporated forward and aft guide shoes to fit into a channel on a launch structure, as well as wing ailerons and provision in the nose to accommodate different size weapons configurations. This design also had its horizontal tailplane raised to the lower part of the vertical fin in order to accommodate four SG 34s, as was the case with the first 50 'M' types.

It was envisaged that the delayed, long-term series production of the Ba 349 would commence in March 1945. The demand was for at least 200 initial machines.



A later-style arrangement of the externally mounted Schmidding booster rockets. Also visible is the vent pipe of the internal Walter rocket motor.

There had been a major step forward in the *Natter* programme when, during the afternoon of 3 November, the M1 prototype glider carried out the first towed air trial under the auspices of the DFS's aerodynamic section at Neuburg an der Donau, some 140km to the north-east of the Bachem-Werk at Waldsee. The DFS carried out most of its glider trials at Neuburg and had gathered an experienced team of aviators to undertake the first test with the BP-20 M1.

The M1 *Natter* was to be towed into the air by a Heinkel He 111 that would be flown by Flugkapitän Hermann Zitter. Zitter, a Wasserkuppe veteran from 1928, had trained for blind-flying with Deutsche Lufthansa in Berlin in 1937, and the same year also trained at the *Erprobungsstelle* at Rechlin on powered aircraft. In 1936, he had worked as a glider instructor, specializing in towing. Zitter had joined the DFS at Ainring in 1940, where he used his towing skills to assist in various experiments, including the first towed flights with a *Mistel* composite combination. His crew comprised Kreyser as observer, Roschlau as radio operator and Kaffenburg as flight engineer.

For this historic event, the *Natter* would be flown by Erich Klöckner. In 1939, Klöckner had become the first glider pilot to reach 9,280m over the central Alps, thus establishing a new altitude record, and a year later he reached the edge of the stratosphere in a glider. Also, like Zitter, Klöckner had been involved in the *Mistel* flight trials. For the test flight, Klöckner would have contact with Kreyser via a hard-wire connection with the Heinkel.

Overseeing the pre-flight checks was Dipl.-Ing. Hans Zacher of the DFS. Zacher had commenced his studies at the *Technische Universität* in Darmstadt in 1933 and was a member of the local *Akaflieg*. He was the author of various assessment reports on pre-war gliders.

The test team in discussion at Neuburg ahead of the flight of the M1 on the grey autumn afternoon of 3 November 1944. To the right is the M1 test pilot, Erich Klöckner, while second from right is believed to be Dipl.-Ing. Hans Zacher of the DFS.

The BP-20 M1 sits on its take-off trolley with the tail of the He 111 towplane visible to the left.

For the trial, the M1 had been mounted onto a purpose-built, triangular, take-off trolley made of tubular steel and attached to it at the joins between the *Natter*'s nose and centre fuselage and the centre fuselage and rear fuselage. The trolley had a nosewheel at its forward point and two rear wheels. The front wheel was linked mechanically to the rudder pedals of the *Natter* to enable steering. The *Natter* was also equipped with an airspeed indicator, the pitot tube being fitted to the right side of the nose. The *Natter* was hooked up to the He 111 by means of a 60m cable that was attached to the underside of the Heinkel at a point close to its centre of gravity, and then split about six metres from the *Natter* so that it could link to each of its wingtips. It was hoped that with such an arrangement, any yawing movements on the part of the *Natter* would be limited, and it would be possible to land the glider unmanned.

To observe the flight in the air, a Junkers Ju 87 flown by Karl von Jan, another member of the DFS test team, together with a cameraman, would monitor the test.

The BP-20 M1 waits to be linked to a He 111 towplane during air trials at Neuburg on the afternoon of 3 November 1944. The *Natter* would be flown by Erich Klöckner and the He 111 by Hermann Zitter, both extremely experienced aviators from the DFS. The M1 was 'smashed during several wing-overs moving forwards and sideways on.'

At 1600hrs, amidst misty grey November skies, the He 111 began to roll along the runway at Neuburg with the BP-20 M1 trailing behind it. The trolley seemed to handle well and at 80–85 degrees it lifted off the ground. At just three metres from the ground, it was successfully jettisoned. The Ju 87 was also airborne.

Initially, in the M1, using all his skill and experience, Erich Klöckner fought to control the little craft as it began to swing around in the air, but eventually it settled into a steady course. At 200km/h, all the control surfaces functioned. However, Klöckner next pulled back on the control column in an attempt to bring the *Natter* into a normal towed flight attitude, but the craft suddenly jerked and fell through the air. The tow cable also recoiled, something that the crew of the He 111 were also aware of. Klöckner was thrown about inside the little cabin of the *Natter* and thumped his head on the roof. He eventually repositioned a trim weight and was able to ascertain that in level flight at 240km/h, the *Natter* responded to rudder deflection. However, attempts to determine the stalling speed were confounded by the craft bucking, and problems with the linkage with the He 111 prevented further tests, while the bucking and shaking also restricted full testing of the elevators.

Klöckner was eventually forced to bail out when it became apparent that he would be unable to bring the *Natter* into an acceptable towed position to allow the drag or salvage parachutes to be deployed. As he bailed out, the canopy roof became snagged on its hinge and failed to fall away. Klöckner exited the *Natter* by jumping to the left, and after four seconds of descent he opened his personal parachute, landing safely.

As the He 111 landed at 170km/h, descending at a rate of 0.5m per second, the M1 trailed behind it and was eventually released. It then veered away and broke apart. As Klöckner and Kreyser subsequently reported, 'The M1 touches the ground 80m before the airfield boundary, it leaps back up, comes down again slightly twisted (in the Z [vertical] axis, at the same time being released from the He 111) and is smashed during several wing-overs moving forwards and sideways on.' It was later discovered that the *Natter*'s instability was due to the suspension being attached behind its aerodynamic centre.

The destruction of the M1 may have been a setback, but it did not stop progress, or Bachem's resolve. To go some way towards avoiding a repetition of the fate of the M1 and to create a manned machine that could be tested repeatedly, another engineless prototype *Natter*, the M3, was fitted with landing gear. The M3 was completed on 20 November and fitted with a tricycle undercarriage, the nosewheel attached via a yoke to a pivot. This machine also had air brakes fitted to the sides of the rear fuselage, and weighed a total of 740kg. The same personnel that had been involved with the flight-testing of the M1 were involved with the M3, aside from Kaffenburg being replaced as flight engineer by Lohfink. The suspension point of the towing harness was attached to the wings at 24 per cent of chord corresponding to the centre of gravity of the machine.

The BP-20 M3 was completed with a tricycle undercarriage. It was air-tested with Erich Klöckner at the controls on 14 December 1944 and reached 260km/h, being towed by a He 111. The flight test went relatively well, but the M3 sustained damage on landing.

The M3 took to the air on 14 December 1944, with Klöckner at the controls, once more towed by Zitter in the He 111. The *Natter* sped along the runway without any problem and the flailing in the air that took place with the M1 was repeated at first in the M3, but it quickly stabilized. Zitter reached 2,500m and settled the Heinkel down to cruising speed. In the *Natter*, Klöckner tested the elevators while climbing at 200km/h – all was good. But when speed was increased to 260km/h, the elevators locked as the pilot pulled back on the control column, the *Natter* swinging on the cable. Klöckner repeated this three times, generating the same results, but the aircraft did not shake in the air. He adjusted the trimming weight, but a little later his communications link with the He 111 failed. The combination flew on without communications for ten minutes at 900m and 170km/h, after which Zitter decided to land. He repeatedly signalled that he would be landing in the hope that Klöckner would hear and bail out over the airfield. He must have heard, for he moved the trimming weight into the forward position and, over the aerodrome, he jettisoned the cockpit hood and bailed out from the aircraft.

The M3 continued to 'fly' on, attached to its cable. Zitter then touched down, letting the *Natter* land at around one metre per second behind the Heinkel, before releasing the cable, which then pulled away behind the little glider. The M3 continued to move forward on a perfectly straight course, but finally rolled into a grass verge. At some point during the landing, the right mainwheel mount had become bent backwards, otherwise no other damage had been sustained.

Meanwhile, in the closing weeks of 1944, in another significant development, personnel from the SS *Sonderkommando Waldsee* had

been overseeing the erection of a 20m-tall VTO launch tower for the *Natter* at the military training ground at Heuberg, an upland near Stetten am kalten Markt, some 80km to the north-west of the Bachem-Werk at Waldsee. The need was for a remote, open area with limited access so that the VTO rocket trials could be carried out under conditions of secrecy and security. The vast, semi-wooded site at Heuberg was ideal, and a high, open area of it known as the Ochsenkopf was allocated to *Projekt Natter*. As with the manned, glider trials, the actual launch proceedings appear to have been placed under the direction of the DFS, but the construction aspects were coordinated by SS-Obersturmführer Flessner. So secret was their activity that the SS personnel involved were warned that any breach of security would result in court martial and possible execution by firing squad.

A Bachem BP-20 *Natter* blasts into the air from the launch tower at Heuberg in late 1944.

The steel framework components of the tower, essentially scaffolding, had been fabricated by the Firma Maschinenfabrik Esslingen, an engineering company based in Esslingen, and a piece of ground on the Ochsenkopf had been levelled out to allow the base frame to be laid down. This box frame was weighted in place by metal boxes for ballast, possibly sand, at each end. The design of the base frame included a wheel under each weight, which allowed it to be rotated on a circular track, but as far as is known, the tower stayed locked in one position for all launches that eventually took place.

The tower was of a very rudimentary form, box-like and hinged at the join between the lower third and upper two-thirds. The angle of the tower could be set between 90 degrees and 70 degrees to the horizontal by means of a crank to which was attached a threaded ramrod. The ability to move up and down the tower was provided by a ladder built inside the frame that ran its entire length. A lifting crane was installed, but there were no other work platforms, so a head for heights was a prerequisite on the part of the *Natter* work crews. To accommodate the *Natter*, pairs of channelled guideways were fitted to metal arms

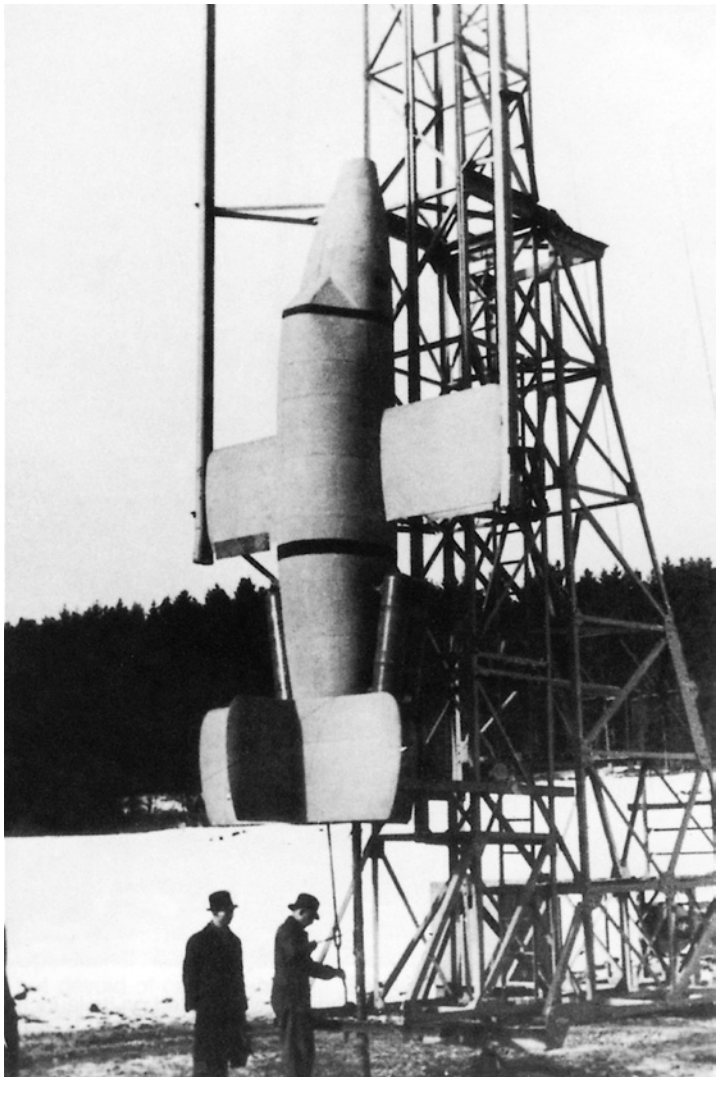
that extended from the framework into which the wingtips of the interceptor would be fitted for launch. Another guideway on the front elevation of the tower took the guide shoe of the lower vertical tail fin. The Firma Maschinenfabrik Esslingen had also supplied a simple, box-framed jib crane with a block and tackle hoist.

Trenches were dug for shelter some 50m from the tower, together with an observation bunker, probably of timber and earth, to be used by Erich Bachem and his engineers. *Natter*s arriving for trials from Waldsee were to be delivered to a guarded shed, while other sheds were intended to accommodate guards and technicians, as well as to provide a space for pre-launch checks and adjustments.

In mid-December, M21 arrived at Heuberg from Waldsee on a truck. With the launch tower now built, the measurements of the *Natter* were finite – a wingspan of 3.6m, the 2.3m span of the horizontal tailplane and the 2.4m-tall vertical tail fin. M21 had no functional rudders, and its primary purpose was to test the launch equipment, booster rockets, the *Startfalle* (the automatic latch to release the *Natter* once all booster rockets were firing) and the actual VTO. The *Startfalle* comprised two rods that tethered the *Natter* to the tower. Each rod had two explosive bolts fitted to its upper end. When all four SG 34s were firing, an electrical circuit system detonated the bolts and released the aircraft. No testing involving nose separation or recovery was to be undertaken with M21 on this occasion.

On 18 December, M21 was lifted off its truck by the crane, but problems became apparent immediately – not least of which was the fact that the lifting hoist harness was inadequate and unable to properly move the *Natter* to the tower. Additionally, there were difficulties with the tower crane, which pulled the interceptor too close to the metalwork, thus hindering the placement of the wingtips and tail fin guide shoe into their channels. At one point, the *Natter* rolled 180 degrees in the air around its longitudinal axis, slipped away from the jib crane and fell to the ground. Finally, after much consternation, the *Natter* was fixed to the tower, which had apparently been lowered to an angle of 70 degrees, and then cranked up to the vertical. Four Schmidding SG 34 rocket booster units were then fitted to the fuselage and the igniter cable run from inside the booster casings over to the observation bunker.

With Bachem and his engineers in their earthwork bunker and the launch crew having taken shelter in their trenches, a sense of excitement and expectation hung over Heuberg. After a few moments, the launch process began and firing buttons were pressed in the bunkers. The Walter rocket and Schmidding boosters duly fired, but when the *Startfalle* was deployed, the explosive bolts failed to detonate under both automatic and manual means. For a few seconds, there was a tremendous noise and a rising cloud of dust, with scrub and rocks flung across the immediate area. Flames were observed at the rear end of the fuselage before the *Natter* erupted and was consumed by fire, burning out entirely. It was a blow to the Bachem team's hopes, but once again they were determined to carry on with their work. The problems with the design of the launch tower and the fitting of the



The M16 sits in its guide rails against the Heuberg tower on 22 December 1944 as Bachem personnel secure a tethering rod. Small trim tabs had been fitted to the trailing edges of the wings, intended to assist in rotating the craft around its longitudinal axis to aid stability during vertical flight. The launch was delayed because of cable problems. The *Natter* reached an altitude of 800m before crashing to the ground. Visible here is the access ladder built inside the launch tower.

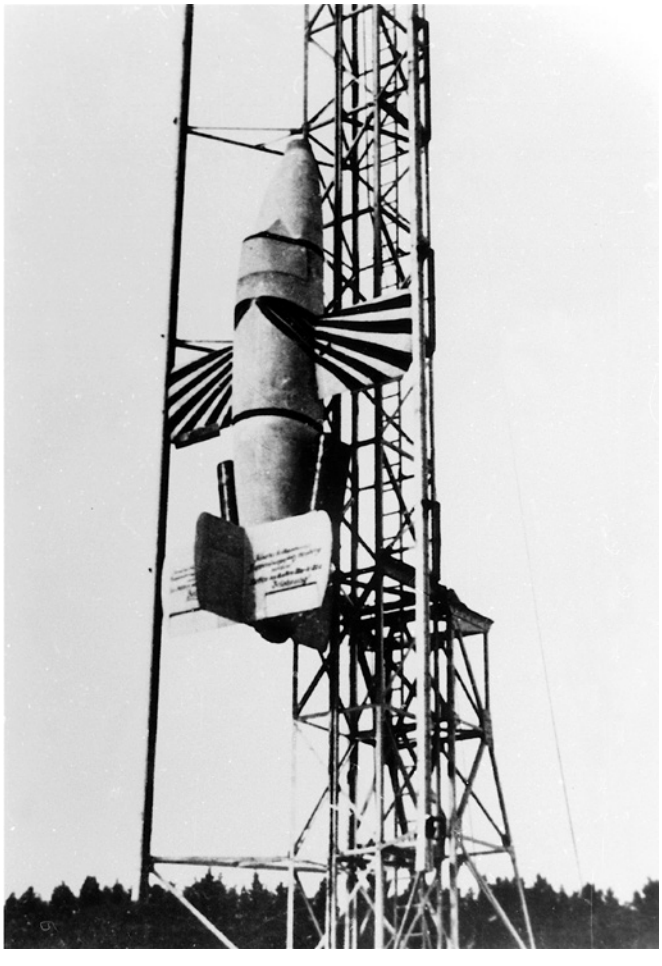
*Natter* to it were not insurmountable, but the crane arrangement needed improvement.

Two days after the abortive launch attempt of M21, another prototype, the light-coloured M16, arrived at Heuberg from the Bachem-Werk. This time the fitting of the *Natter* to the tower proceeded without difficulty within an hour. Weighing 1,630kg, this craft was enhanced by the addition of small trim tabs to the trailing edges of the wings that were intended to incite the machine to rotate slowly around its longitudinal axis in order to promote stability during vertical flight and to counter any shortcomings in construction.

On 22 December, by which time winter had cast an icy grip over Heuberg with temperatures falling to -6°C, the M16 stood against the bottom of the launch tower, its nose pointing vertically towards the cold, grey sky. There was a delay to the launch of some hours as a result of the ignition cables leading from the booster rockets being

wrongly connected due to them not being properly marked. Despite several attempts at reconnecting, M16 remained immobile, and so the ignition voltage was eventually doubled from 24 to 48 volts. At this, the boosters fired, but with one SG 34 at only partial thrust, the *Natter* moved slowly up the length of the tower at 18m per second, with total thrust at 2,910kg against the expected 4,800kg. Nevertheless, the flight path of the *Natter* remained vertical and stable during VTO. At a height of 70m, it began to rotate slowly and then fell a little towards its right side into the prevailing wind. It reached a maximum height of 800m, before descending and crashing to earth some 1.6km from the launch site, where it exploded. The booster rockets also came apart, and in the case of the unit that failed to fully fire, traces of unburnt powder charge lay on the ground.

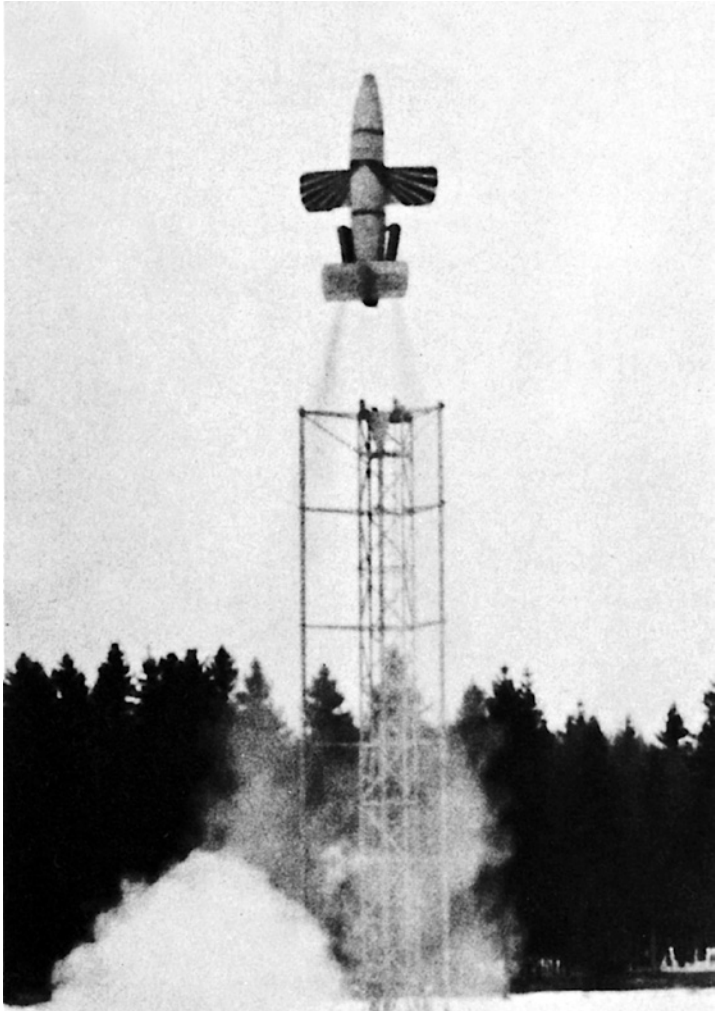
For the Bachem team, the successful launch of M16 showed that a BP-20 could take off at a lower-than-expected speed, but maintain stability during flight, despite a failed booster and prevailing wind blowing from the side. Additionally, in the period leading up to launch, the groundcrews had realized that when it came to manned launches, a gangway should be built into the tower to allow a pilot to climb into, and if necessary, to exit the aircraft, with the ability for it to be swung upwards and away so as not to hinder launch.



The distinctively marked M17 held higher up the tower than usual with its wingtips and tail fin guide shoe in their rails. The 'sun ray' finish to the wings was probably applied to monitor flight progress from the ground by a film camera. This *Natter* was launched on 29 December 1944.

Despite these generally positive developments, there were those who remained sceptical over the *Natter* concept. Max Mayer was a test pilot based at the Luftwaffe *Versuchsstelle* at Peenemünde-West, where he also specialized in the assessment of unmanned missiles. As head of *Abteilung* E2, he oversaw development of remotely guided missiles and rocket-propelled aircraft. In his capacity as an experimental engineer, on 24 October 1944 he was ordered by the Technical Office of the RLM to evaluate *Projekt Natter*, and on the 30th of that month visited the Bachem-Werk, where he received an 'extensive presentation' on the interceptor from Erich Bachem. Mayer was at the RLM on 3 November, where he gave his impressions on Bachem's creation, and also at the E-*Stelle* Rechlin on the 11th, where he discussed his findings with the *Kommandeur*. He was back at Waldsee on 18/19 December for further discussions. He recalls:

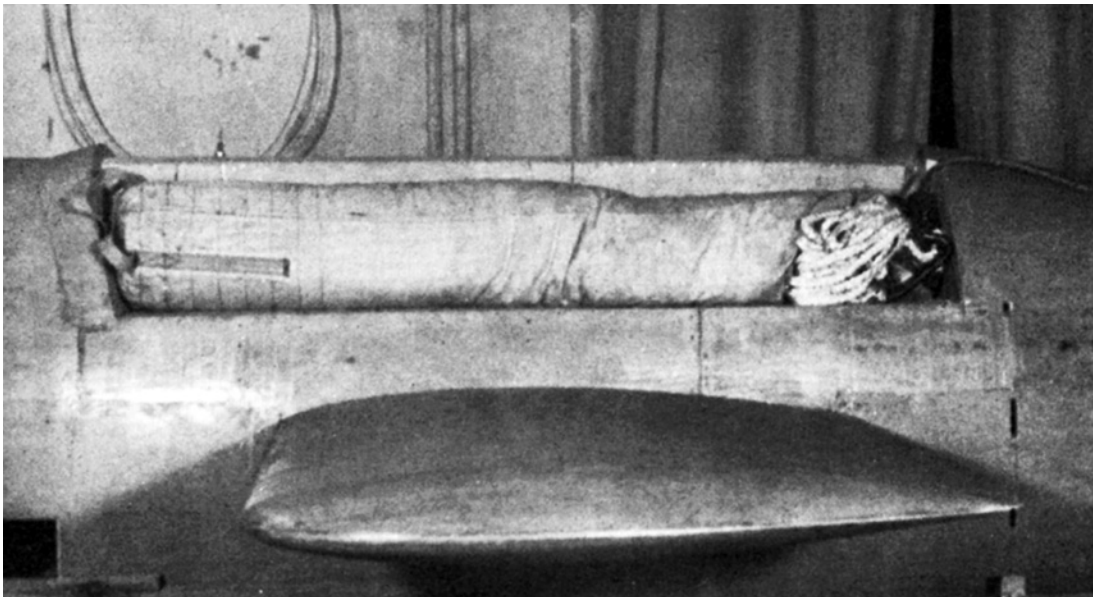
'Although the in-flight behaviour of the *Natter* in towed flight behind an He 111 was regarded as good, my judgement turned out to be negative for



The M17 takes off. Shortly afterwards, however, the aircraft's salvage parachute failed to open and it broke up after hitting the ground.

the following reasons – the hardly manageable vertical take-off and approach to a high-flying target by young, inexperienced pilots in a new and untested manned aircraft; and the combination of several new or altered components and assemblies that have not yet been tested, coupled with the pressure of time under which development was faced, despite all the optimism displayed by the manufacturer, would not in my view urgently lead to the success of the *Natter* project.'

Nevertheless, at 1234hrs on the bitterly cold afternoon of 29 December, with a slight wind blowing in from the east, BP-20 M17 stood fitted against the launch tower on the snow-covered Ochsenkopf. On this occasion, for trial purposes, the *Natter* was deliberately positioned higher up the tower so that the run was reduced from 17m to 12.5m. This machine was visibly distinctive because of the striking black, asymmetrical 'sun ray' finish that had been applied to the upper surfaces of its light-coloured wings (five beams on the right wing, six on the left), possibly as a measure to monitor flight progress and positioning. Additionally, the surfaces of the horizontal



The open stowage compartment in the lower fuselage for the salvage parachute. The aircraft is photographed lying on its back.

stabilizers had been inscribed with instructions for anyone finding the landed fuselage to telephone a number given for the training area at Heuberg, followed by the very simple incentive of the word, '*Reward!*'

M17 took off without problems, all four of its boosters firing at full thrust, and it rotated around its longitudinal axis as it climbed to around 2,500m in 25 seconds. On its descent, the salvage parachute deployed according to the pre-set timing, but it was ripped away at 700m when the cable snapped at the attachment to the shroud line ring. The parachute failed to open and the BP-20 crashed into the ground after having flown for 52 seconds. Not much was left, but one of the tailplanes with the reward message was recovered, as was the salvage parachute. Once more, however, thrust was well below the expected 1,200kg at 980kg.

Meanwhile, testing continued at Neuburg and Ainring airfields from November 1944 into February 1945. At least four trials are known to have been carried out in which BP-20s were suspended, using bomb carriers, below the wing of a He 111. The objective of these flights was to assess the separation of the nose section from the rest of a *Natter* so as to allow a pilot to exit the aircraft in the safest possible way. It was envisaged that a pilot's own inertia would throw him forwards and away from the cockpit, while a parachute would slow down the movement of the remaining fuselage. This method would free a relatively unskilled pilot from having to open a canopy at high speed, to stand on his feet and then to climb out of the cockpit to bail out, hopefully avoiding impact with the tail unit.

For tests, M2, M5, M6 and M7 were loaded with a dummy pilot attached to a parachute. The process commenced on 7 November 1944, when the wingless M2 took off mounted to the wing of a He 111 from the DFS at Ainring. The Natter was released at just 500m. It spun in the air a few times before crashing to the ground without either the

Smiling Bachem engineers hold up a recovered fragment of the M17's tailplane, marked with the contact details of the Heuberg launch site. There was little else left to salvage.

nose separating or the drag parachute deploying. Examination of the wreckage revealed that the timing mechanisms and explosive release bolts had all functioned, but it was most likely the spring-powered release mechanism that had failed, or else the dummy pilot had moved around in the cockpit, blocking the system!

Further tests were carried out over the Heuberg using M5, M6 and M7, each fitted with two salvage parachutes stowed in the lower fuselage between the wings. Each aircraft had a slightly different shape to its nose/fuselage join and the trials were relatively successful, demonstrating that a pilot could leave the aircraft safely if the nose was separated from the rest of the aircraft and the remainder of the fuselage decelerated by means of a brake parachute. In the case of M5, for example, the *Natter* had entered gliding flight and the nose came away 3.36 seconds after being released from the He 111. At 6.9 seconds, the salvage parachute opened and the dummy pilot was about one aircraft length in front of the *Natter* airframe, and at 10.4 seconds the dummy's parachute deployed. Changes in design to the separation join on each aircraft had little influence on the overall process.

In February 1945, discussions took place between representatives of the SS, RLM and DFS over changes to the position of the BP-20's centre of gravity, specifically in relation to the planned Ba 349A-1 operational *Natter*. This time, however, a free flight was needed for testing purposes and the BP-20 M8, built by the Flugzeugbau Wolf

Hirth, was assigned to the task. The aviator selected to make the first free flight was Luftwaffe test pilot Unteroffizier Hans Zübert, who had considerable experience flying pre-war gliders and the flying wings of the Horten brothers.

On the morning of 14 February 1945, a He 111 flown by Hermann Zitter took off from the Heuberg towing M8. Inside the diminutive BP-20, Zübert was to start breathing oxygen once at 4,000m. Then at 5,000–6,000m, M8 would be released from the Heinkel and Zübert would dive to increase his airspeed to 600km/h before levelling out. He was to then make two horizontal curves, to the left and right, as his speed reduced to about 300km/h. Zübert would then dive again, once more increasing speed to 700km/h. A robot camera would record the instruments. Once the test had been completed, Zübert was to detach the camera, push the control column forward, activate the safety parachute, separate the nose and bail out.

As the Heinkel/BP-20 combination climbed, Zübert tried out the rudder and elevators, which he found to be in good working order. At 5,500m, the *Natter* detached from the He 111, but the release of the couplings was fleetingly out of time and the craft veered into a left-hand dive, although the pilot was able to quickly recover stability. The tests went according to plan, with the turns, dives and airspeeds in order, and the robot camera apparently functioning. However, upon completion of the tests, try as he might, Zübert was unable to deploy the safety parachute, and he bent the release handle with the force of his hand.

He then attempted to activate the switch that detonated the explosive release bolts linking the nose to the fuselage, but once more there was no response. His last chance was to put the BP-20 into a steep climb to reduce speed, eject the canopy and then clamber out. Remarkably, having managed to get himself out and into a seated position on the left side of the cockpit, and with the *Natter* moving at 300km/h, 1,200m above the ground, Zübert coolly read the instruments one more time, just as the craft veered to the left and went into a spiralling dive. Zübert held on for three turns before successfully diving over the left wing and under the tail assembly. He came down in a field close to the banks of the Donau river, while the *Natter* hit the ground close by.

Undeterred by his alarming experience, Hans Zübert later reported, 'My general impression of the machine is very good and I can describe its flying characteristics as very benign.' Nevertheless, he did express his concerns about the limited oxygen supply on board. It also later transpired that an additional screw had been used as an extra safety measure to prevent accidental usage of the safety parachute release lever, but this had not been removed before his flight. Furthermore, incorrect electrical installation meant that the robot camera had not filmed events after all.

Regardless of these issues, a man had flown the *Natter* free for the first time. This was real progress. The next goal was to trial a manned, powered, vertical take-off. The pressure was on to get the *Natter* into the skies to shoot down bombers, otherwise its appeal with the SS and the RLM might wear thin.

CHAPTER FOUR

# ‘UNRESERVEDLY POSITIVE’

Members of the SS *Sonderkommando* Waldsee prepare to fit the nose section on to what appears to be a *Natter* fuselage mock-up, possibly for training purposes. The nose is fitted with a honeycomb launch rack either for 24 RZ 7.3cm RS *Föhn* rockets or 30mm MK 108 cannon shells.

Concurrent to the aeronautical design and development of the Bachem *Natter* was the consideration of suitable weapons systems for the aircraft. The Ba 349 was intended as an aerial weapon of war to be deployed specifically against enemy bombers. In the early stages of its design, the plan was to arm the aircraft with two 30mm MK 108 cannon, each with 30 high-explosive ‘M’ shells – *Minen Geschoss* (mine shell) – since analysis had concluded that greater damage could be inflicted to the stressed skin finish of a bomber by blast than by metal splinters. However, in the spring of 1945, a dramatic new development was underway which would strengthen the Luftwaffe’s aerial arsenal significantly.

For many months, German ballistics engineers had recognized that the installation of air-to-air rockets would become ‘indispensable’ as the possibility of introducing fixed armament of greater range into a single fighter aircraft became increasingly difficult. Throughout the latter half of 1943 and into 1944, the Luftwaffe’s conventional fighters relied primarily on heavy cannon, such as the 20mm MG 151/20 and 30mm MK 108. These had proved generally effective, especially when used by more skilled pilots – just a few well-aimed 30mm rounds was enough to destroy a B-17 or B-24. However, the increase in defensive firepower of Allied bomber formations, combined with ever-growing numbers of long-range escort fighters, meant that for a German fighter pilot to get close enough to a bomber formation, or *Pulk*, to ensure success was becoming harder and harder. Even the heavily armoured and armed Fw 190A-8 *Sturmjäger*, intended as a close-range anti-bomber interceptor, did not bring sufficient reward – there were just not the numbers available to inflict serious losses.

In addition, throughout the latter half of 1943 and into 1944, several Luftwaffe single-engined fighter units and *Zerstörergruppen*, the latter operating twin-engined Bf 110s and Me 410s in the defence of the Reich, had been equipped with the relatively primitive and hastily converted tube-launched, spin-stabilized 21cm W.Gr. 21 (*Werfer-Granate*) army mortar shell in an attempt to break up heavy bomber formations by blast effect. But the weapon proved generally inaccurate and successes were negligible, with only isolated impact being made on a tightly formed bomber *Pulk*.

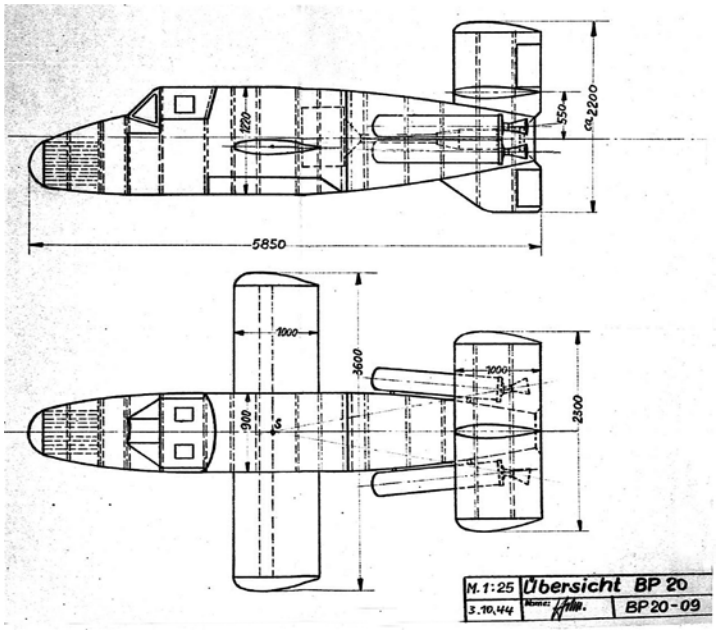
Following the mixed success of the W.Gr. 21, the only plausible alternative was for a fighter formation to attack a bomber formation simultaneously firing batteries of rockets carried either in underwing racks or in nose-mounted 'honeycombs', with which a dense 'fire-chain' could be created that would be impossible for the bombers to avoid. In June 1944, the *Amtsgruppe Flieger-Entwicklung* (Flight Development Section) of *Abteilung* (Aircraft Armament) E6 of the head of the Technical Equipment Office put forward a requirement for an electrically fired, fin-stabilized weapon whose warhead would contain sufficient explosive to destroy a four-engined bomber in one hit. Four weeks later, a powerful consortium of companies, each with individual responsibility for different components, was formed and led by the *Deutsches Waffen und Munitionsfabrik* (DWM) Research Institute of Lübeck.

This consortium duly presented the Technical Equipment Office with a proposal for an 814mm-long, 55mm-calibre rocket with a warhead containing 520g of HTA explosive and ignited by an AZR 2 detonator, all bearing a weight of 3,500g. The rocket was intended to be launched against aerial targets from a range of 800m and be stabilized by eight fins that would open automatically by aerodynamic drag immediately after launching.

The proposal was received favourably and the designation 'R4M' (*Rakete* 4kg *Minenkopf*) applied to the project. Firing trials took place at the end of October 1944 on the Strehla range at the Westin works of Brünn AG and at Kurt Heber at Osteroda. However, the *Erprobungsstellen* at Rechlin (which had conducted the first air launches in December 1944) and Tarnewitz both judged that the missile was still unsatisfactory as a result of the poor standard of manufacture of some individual parts. By the end of January 1945, once some initial burn-out problems had been solved, a general re-working of the rocket, incorporating various aerodynamic and warhead refinements, was conducted.

In its final form, the R4M appeared as an unrotated, rail or tube-launched, single venturi, solid fuel-propelled, multi-fin stabilized missile, with the warhead contained in an exceptionally thin 1mm sheet steel case enclosed in two pressed steel sections that were welded together and held the Hexogen high-explosive charge. The missile bore a high charge-weight to case-weight ratio.

Operational evaluation of the R4M was conducted by Major Georg Christl's *Jagdgruppe* 10 based at Redlin, near Osteroda. Christl's unit had been assigned the task of testing various types of experimental




A Bachem drawing from 3 October 1944 showing a modified tail assembly, four booster rockets and nose weapon armament.

weapons systems produced by manufacturers that were intended specifically as advanced fighter armament in the war against the bombers. On 21 February 1945, a total of 200 practice missiles (R4M-Gbs) were delivered to the unit, but still defects were observed, including corrosion in the combustion chambers and the warheads that DWM diagnosed as a 'non-homogeneous mixing of powder'. These problems were eventually rectified and a pyrotechnic trials session followed in which the rockets 'smoked around in wild curves', having been fired from a static Fw 190. Christl and his technical officer, Hauptmann Karl Kiefer, then developed a wooden underwing launching rack to carry 12 rockets. Still the pattern of fire dispersal was far too wide, so Christl and Kiefer attempted to fire the missiles at intervals using a bomb release switch taken from a He 177. Eventually, it was found that control could be gained if six rockets were launched in two salvoes. Christl recommended that the first consignment of R4Ms be despatched to the base of the Me 262-equipped 11./JG 7 at Parchim following eventual trouble-free launching on 15 March 1945.

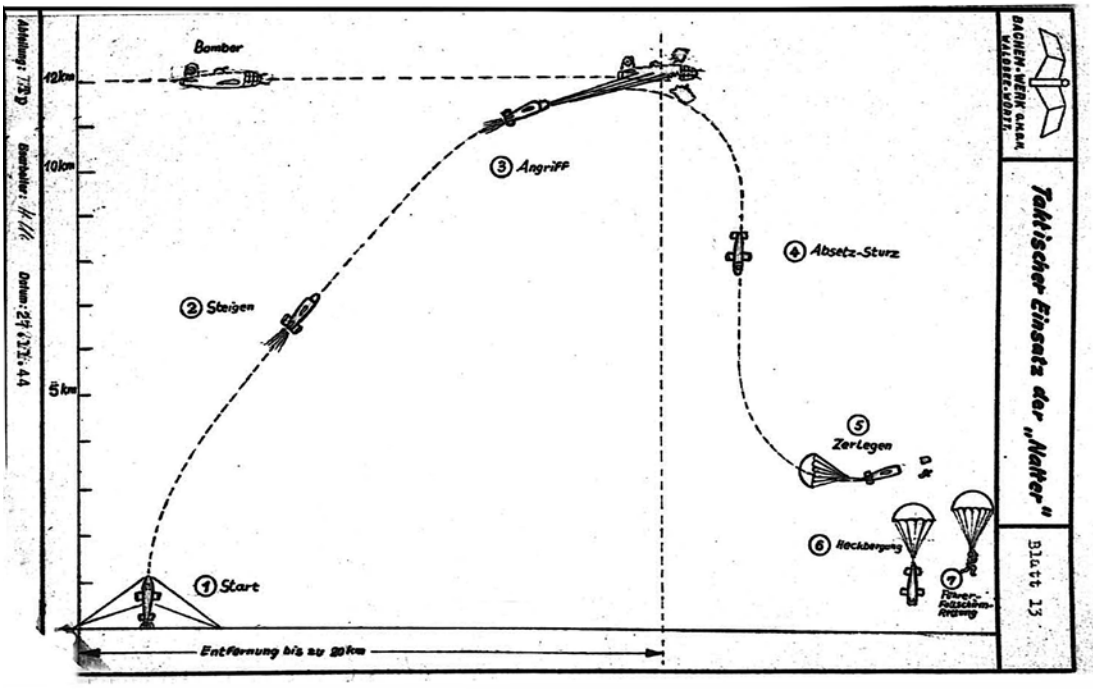
With the Me 262, it was intended to launch the R4M from wooden underwing racks, usually with a maximum load of 12 rockets beneath each wing using a 21kg rack. On 10 March 1945, the Inspector of Day Fighters, Oberstleutnant Walter Dahl, visited Parchim and watched Oberleutant Günther Wegmann of III./JG 7 fly a demonstration in one of the newly armed Me 262s. Using an old Savoia transport aircraft parked on the edge of the airfield as a target, Wegmann made a gentle descent and fired all his rockets. The Savoia was completely destroyed. Eight days later, nearly 1,200 US heavy bombers attacked railway and armaments factories in the Berlin area. They were escorted by 426 fighters. 9./JG 7 put up six aircraft, each fitted with two underwing batteries of 12 of the new R4M rockets. The jets intercepted the

*Viermots* (a contraction of 'four-engines') over Rathenow, and a total of 144 rockets were fired into the American formation from distances of between 400–600m. Pilots reported astonishing amounts of resulting debris and aluminium fragments – pieces of wing, engines and cockpits flying through the air from aircraft hit by the missiles.

Oberfähnrich Walter Windisch was one of the first pilots from JG 7 to experience the effect of the R4M in operational conditions. 'Flying the Me 262 was like a kind of "life insurance",' he recalled, 'but I was on that first sortie on 18 March during which the R4M rockets were used, and I experienced something beyond my conception. The destructive effect against the targets was immense. It almost gave me a feeling of being invincible. However, the launching grids for the rockets were not of optimum design – they were still too rough and ready, and compared with conventionally powered aircraft, when you went into a turn with the Me 262, flying became a lot more difficult because the trimming was not too good.'

In the autumn of 1944, ballistics specialists at the Automatic Weapons Munitions Department at WKW, the Weapons Research and Development Division of the Rheinmetall-Borsig Works and Proving Ground at Unterlüss, 50km north-west of Celle, conducted feasibility studies into developing 'honeycomb' launch pods, loaded with R4Ms, under the wings of the He 162 *Volksjäger*. A post-war report prepared by Rheinmetall-Borsig on the feasibility of mounting such a system onto the He 162 stated:

'The R4M leaves behind a considerable stream of gas flows which means it cannot be installed in front of other cell components and consequently the only arrangement which can be considered is under




'Tactical Operations for the *Natter*' – a Bachem illustration, dated 27 November 1944, showing, in basic form, how a *Natter* was to have attacked an enemy bomber flying at an altitude of 12,000m. 1 – Take-off; 2 – Climb; 3 – Attack; 4 – Descent Course; 5 – Separation (nose from fuselage); 6 – Recovery of Rear Section; and 7 – Pilot Parachute Return. The distance covered from take-off to attack would have been up to 20km.

the wings. It was planned to accommodate 30 rockets under each wing, packed tightly together and loaded into a hexagonal honeycomb container. With such an arrangement only two rounds can be fired at a time, one round from each honeycomb. There must be an interval of 70 ms [milliseconds] between rounds in order to prevent succeeding projectiles being obstructed by the preceding ones. A rate of fire of 1,700 rounds per minute is therefore achievable.

'By sub-dividing the 30-cell honeycomb into two combs with 15 rounds each and suspending them under the wing at a distance of approximately 500mm apart, it is possible at any time to discharge four rounds simultaneously, thereby raising the cyclic rate to 3,400 rounds per minute. Since the R4M has a calibre of 5cm, this is a considerable improvement in performance compared with other armament installations.

'The firing of a burst of four rounds is effected by means of an electrical cylinder switch, such as has been designed for the SG 119. It is possible in this way to fire continuous bursts, as well as release a pre-determined number of bursts.

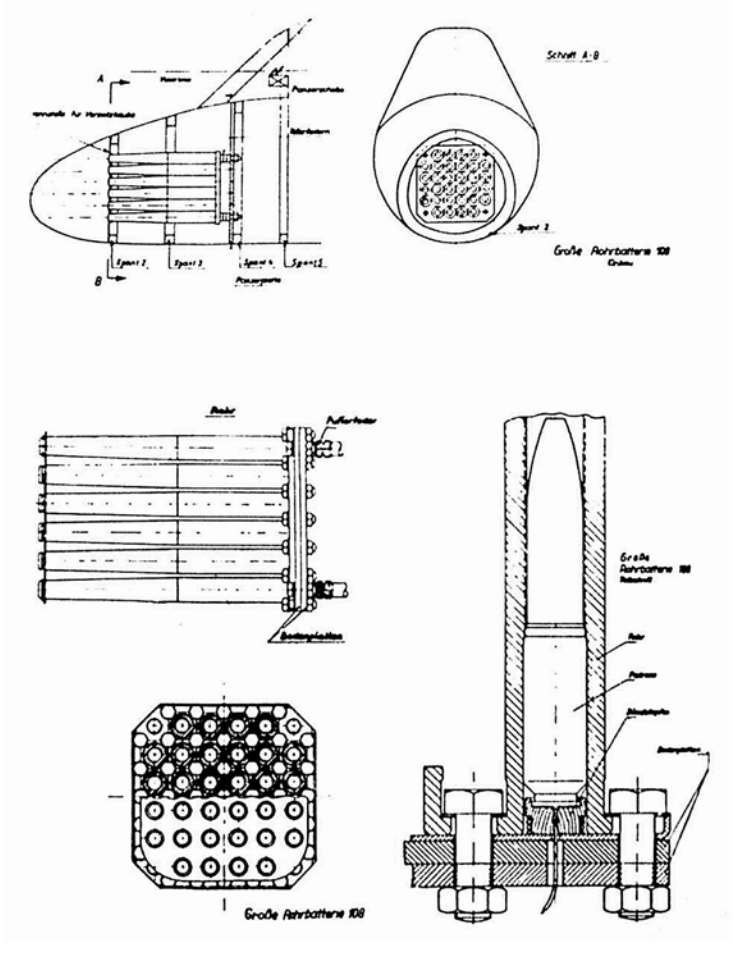
'The honeycomb magazines are enclosed in an aerodynamic cover, which is discarded by the pilot before the attack by igniting a combustible tape.

'The weight of the complete weapon installation including the ammunition is approximately 250kg. An advantage here is that after firing the rockets, the aircraft has only 40kg to carry, and this can also be jettisoned if desired. In other weapon installations high dead weights or the armament remains with the aircraft.'

The fundamental purpose of the *Natter* was to destroy at least one bomber during its mission, and in this regard, the aircraft's entire nose section was intended to hold a weapons system. A 'honeycomb' launcher would 'fit' perfectly. In the *Natter*, a grid of 32 R4Ms could be accommodated behind a jettisonable cover.

Another weapon option was the installation of the SG 119 ('SG' standing for *Sonder Gerät* – 'special device'). With rigidly fixed machine gun or cannon armament, a fighter pilot was required to fly directly at his target and remain 'locked on' to it in his sights for several seconds in order to ensure a sufficient number of strikes with a comfortable degree of probability. In order to reduce this period, during which the pilot and fighter would be exposed to defensive fire, the Germans endeavoured to develop weapons offering a 'spray fire', 'fan fire' or '*Schrotschuss*' (shotgun fire) effect, resembling a wide 'blast' or arc of fire, rather than a single stream or 'chain fire'. The SG 119 was a progressive development of the SG 117 in which a battery of seven barrels each containing one 30mm MK 108 cannon round were clustered cylindrically, held together by a metal brace, running to a breechblock and fired by means of an electric connection. The shells left the barrels sequentially.

A further development was the SG 118, which comprised three SG 117s fixed to a central shaft, the shaft being attached to a coil spring that rotated each barrel battery into firing position. The SG 119 expanded on this design, clustering seven SG 117 tubes into a cylinder, creating a battery of 49 tubes. The theory was that the pilot of the




Diagrams showing the proposed installation of a *Grosse Rohrbatterie 108* in the nose of a *Natter*. This was a one-time-use battery block made up of 32 barrels, each loaded with a 30mm MK 108 cannon shell. The most skilled Me 262 pilots claimed that just three or four well-aimed hits with 30mm shells fired from the jet's four nose-mounted cannon was sufficient to shoot down a B-17 or B-24. Thus, the potential destructive effect of such a battery can only be imagined.

fighter needed to keep the target in his sights for less than one second, with all barrels being discharged within 0.3 seconds.

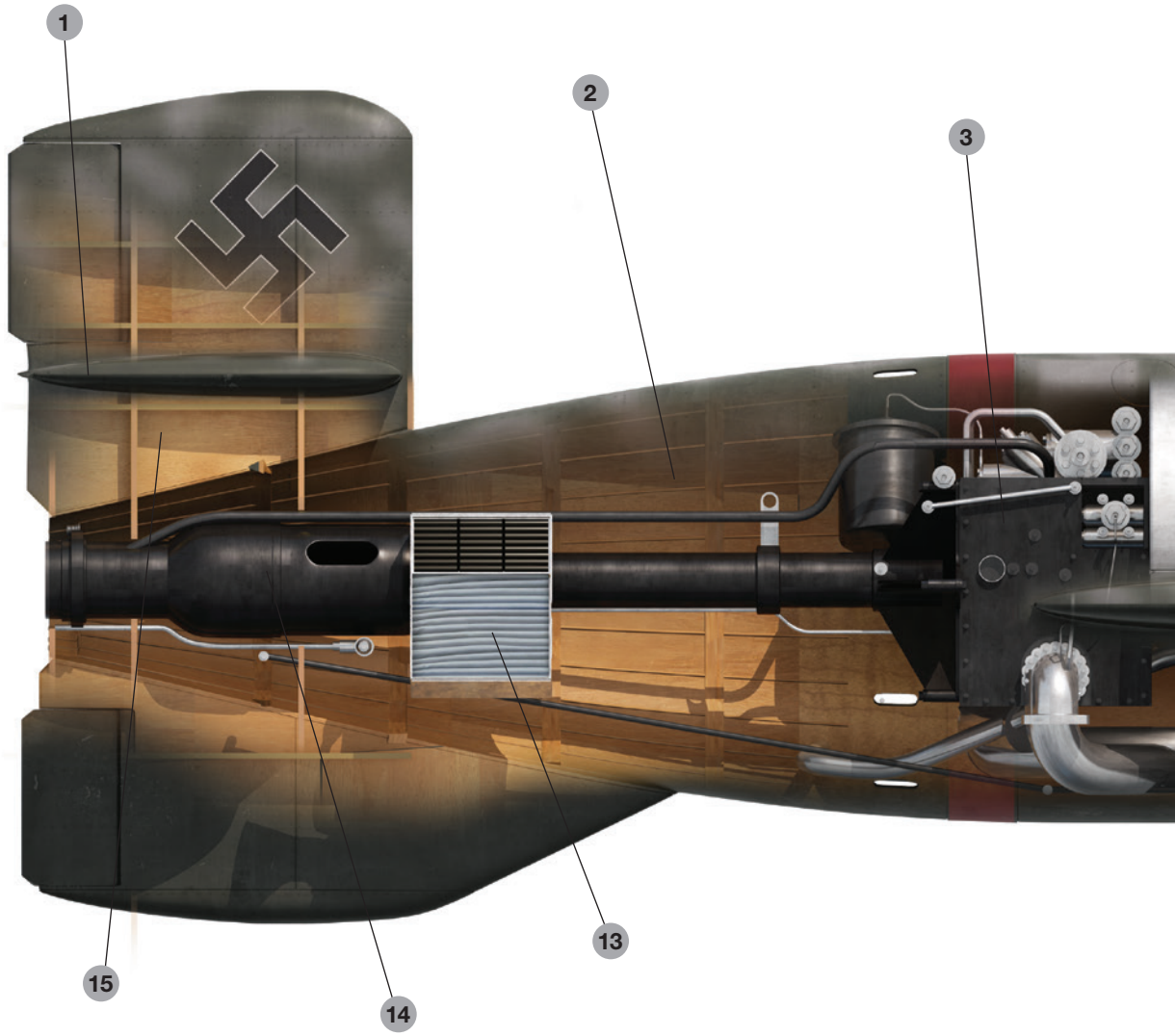
In planning to install the SG 119 into the nose of the *Natter*, there was a need to keep the recoil to a minimum. To accomplish this, all the barrels were connected electrically to a spring-driven distributor. When the first round was fired, the whole battery moved to the rear of the cylinder, but was returned by means of a strong spring. The second round was discharged as the battery came forward, with the next fired round slowing the forward momentum of the battery, absorbing its recoil. In a study of October 1944, Dr Kokott of Rheinmetall-Borsig at Unterlüss compared the tactical and ballistics benefits of the chain fire emanating from two fixed MK 108s and the fan fire created from a battery of 32 30mm tubes. According to Kokott, 'a fighter can pretty well count on being shot down before reaching 300m – i.e., in the case of an armament with two MK 108, before he has fired the 60 rounds required to bring down his opponent.

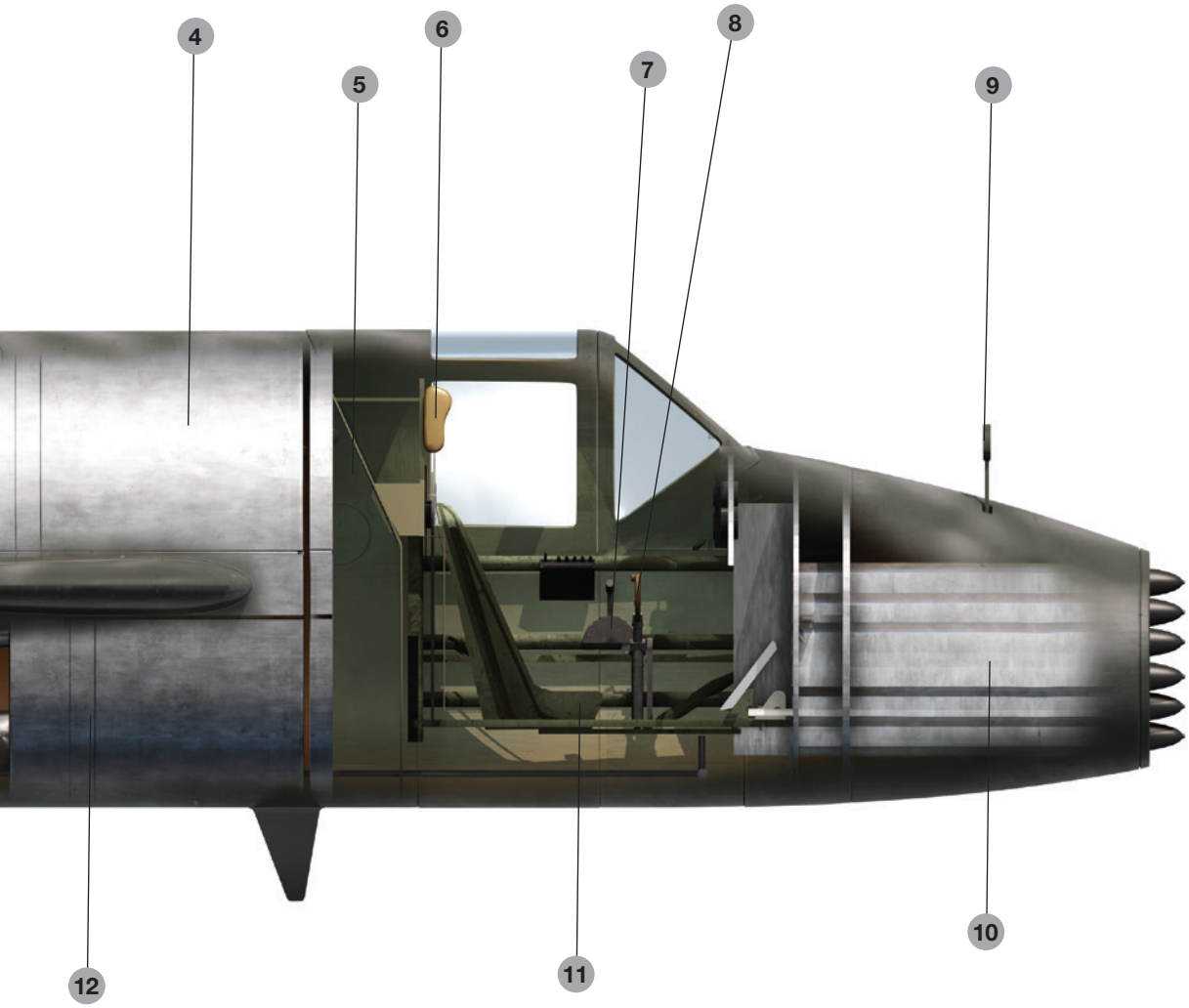
'It is a well-established fact that a fighter comes into effective defensive fire at a range of 1,000m, and is then exposed to it for seven seconds. And only after these seven seconds does it arrive at the 300m range. The rear defence of the bomber is the strongest. A single bomber can generally mobilise a rear defence of ten machine guns. This means, with the rate of fire of the American 0.50-calibre of 850 rounds per minute, that the fighter encounters a cone of fire of 1,200 rounds and flies right into it. In that case the bomber fires under the most favourable conditions – viz. without deflection and with the best point of aim, as no crossing speeds occur.

'Even if we assume the *Natter* is relatively insensitive to projectiles, an attack from behind is, in our opinion, out of the question. The speed of the *Natter*, which constitutes a very high percentage of its fighting value, cannot be made full use of with this method of attack. When attacking from behind, from a central position, every fighter is within the defensive range of the bomber for the longest time. From the tactical point of view, the *Natter* should remain within the defensive

# INSIDE THE BACHEM Ba 349

1. Elevons
2. Timber fuselage with frames
3. Walter 109-509 rocket motor
4. T-*Stoff* tank (365l.)
5. Armoured bulkhead
6. Pilot's headrest
7. Throttle lever mounting and lever
8. Control column
9. Ring sight
10. 'Honeycomb' rack for 32x55mm R4M air-to-air rockets
11. Pilot's seat
12. C-*Stoff* tank (165l.)
13. Fuselage landing parachute in spring-loaded container
14. Combustion chamber
15. Internal timber framework

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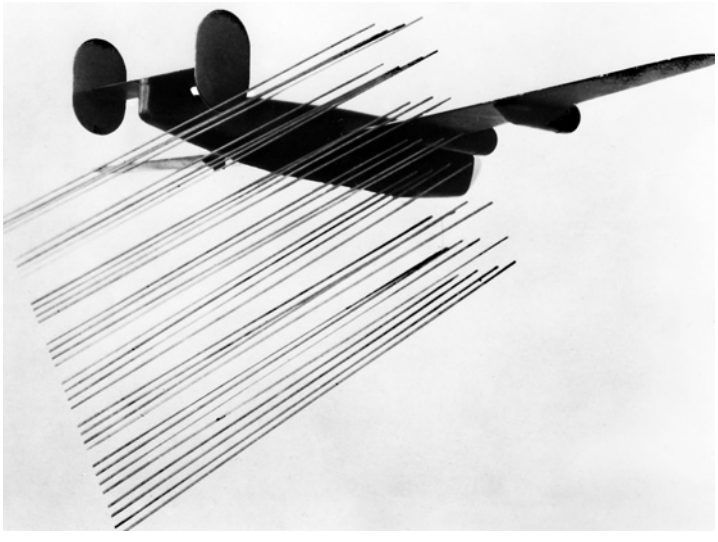


A model of a B-24 Liberator is used to illustrate the effect of *'Schrotschuss'* or 'fan fire' when a battery of 32 MK 108 cannon shells is fired in one salvo at a target from below and behind at an angle of 20 degrees within the space of 0.2 seconds. The *Natter* pilot would have aimed at a point between the wing root and the wing, taking in the bomber's fuel tanks, and would have opened fire at 300m.

range of the bomber for as short a time as possible if full advantage is to be taken of the fighting value of its high speed.'

Kokott also recognized that a direct attack from the front was out of the question due to the great closing speeds involved that would call for pilots of outstanding ability – a luxury that Germany did not have at that stage of the war. Kokott argued 'that only one method of attack remains – viz. the attack from a pursuit curve, the attack being launched at a certain angle to the direction of flight of the bomber. In such a case, it is not open to question that the *Natter* can get within 300m of its adversary. The steeper the angle from which the attack is launched, the safer will be the *Natter* and the shorter time it will be in its adversary's fire. It is of no consequence whether the attack is launched from above, below or from the side. The *Natter* runs no great risk because the bomber's downwards defence is not so strong, and the bomber has now to fire with deflection allowance.'

Kokott and his team of ballistics experts concluded that such a scenario demanded a weapon for the *Natter* with the highest rate of fan fire in which the simultaneous firing of a large number of rounds eliminated all margin for error. Fan fire allowed an interceptor to develop its total firepower at the moment it reached the shortest range between itself and the bomber, and the SG 119 would deliver this capability. According to Kokott, 'The method of firing could not be simpler. The pilot would be instructed to fly against the enemy formation in such a manner that at a range of 1,000m he sees it at an angle of between 30 and 50 degrees. As soon as he has reached a range of 300m – this range he can discern, as the span of the enemy is seen between two marks in his sight – he fires. All he needs to do is to strive for a fine point of aim. The necessary deflection allowance, which is about two degrees, has been set beforehand.

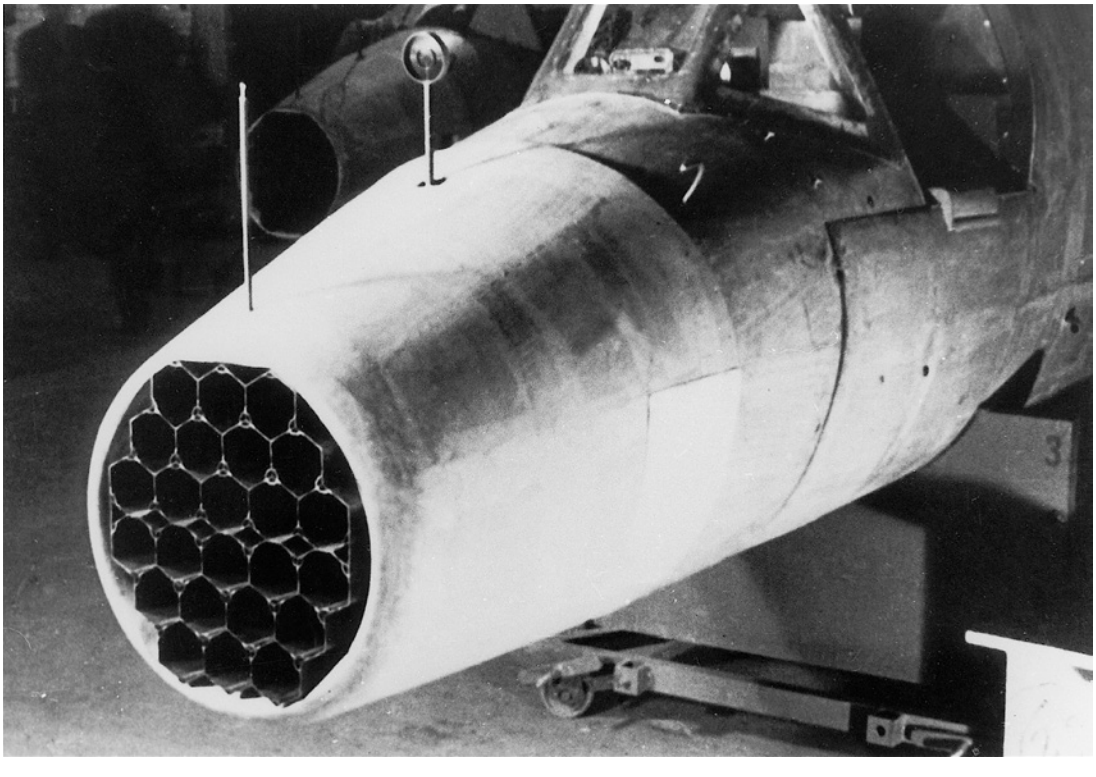
'This simple method of firing we regard as a further advantage of fan fire over chain fire. Chain fire requires an intensive training of the pilot, not only in flying but also in gunnery skills as well. With chain fire

using two MK 108s, the pilot has to concentrate for three seconds upon a correct point of aim and constant corrections. In view of the personnel available, this point of view seems to be of essential importance.'

Regardless of Kokott's scientific approach and logic, when a prototype SG 119 was tested at Unterlüss, despite relatively successful results and the inclusion of a strong buffer spring, recoil was found to be excessive and the weapon was not adopted.

After a delayed start due to there being no delivery of an airframe from Bachem, advance work on the *Natter* concept also began at the Luftwaffe weapons testing facility at Tarnewitz from early November. During mid-November, tests were undertaken with other types of aircraft to assess firing ahead with 'rigid weapons' as well as, according to Tarnewitz reports, with 'oblique armament upwards', which indicates that thought had been given to that type of armament.

It was planned to fly the nose section of a *Natter*, complete with armament, in a Luftwaffe transport aircraft from southern Germany to Tarnewitz, where it would be fitted onto a Bf 110 for air-testing. Before the arrival of the nose, however, described in reports as the '*Natterbug*', the Bf 110 was used to fly mock attacks of the same kind proposed by Bachem and the ballistics technicians at Unterlüss for the *Natter* against a Fi 156 Storch. The level of accuracy for each kind of attack approach was recorded and evaluated. By 9 December, Tarnewitz was still awaiting delivery of the *Natterbug*, but by the 17th, the test centre was informed that a nose section fitted with two MK 108 cannon was on its way from Waldsee. It was further advised by Bachem that a nose



The 24-tube honeycomb launch rack for a battery of RZ 7.3cm RS *Föhn* rockets, as fitted into the nose of a *Natter*. Note also the twin sighting rings.

section fitted with the proposed SG 119 would not be available for trials until the middle of January. It seems nothing further happened.

In February, however, there had been some activity connected with the use of R4M rockets in the *Natter*, although it was found that there were restrictions because the only mode of firing was to salvo all rockets at once. On 19 February, the E-*Stelle* reported that trials with neither the SG 119 nor the R4M had progressed because it was not known when Bachem would have the nose and launchers assembled.

The weapon eventually selected for the *Natter* was the RZ 7.3cm RS (*Raketen Sprenggranat* – Rocket Grenade) *Föhn*, so named after a mountain wind that blows in southern Germany and Austria. Designed as a ground-launched anti-aircraft rocket shell intended for multiple-firing from a vehicle-based battery against formations of low-flying bombers, 35 rockets could be loaded into a simple framework, which could be traversed and elevated, and which was equipped with a rudimentary sight. It is believed that technicians at the *Luftfahrtforschungsanstalt* in Berlin took up the idea of developing the rocket as an air-to-air weapon in the summer of 1944, with some sources stating that production was handed to Henschel, who produced it in limited numbers at Kassel as the 'Hs 217'. By February 1945, 59 launchers are believed to have been in use.

The *Föhn* was spin-stabilized and carried a 280g warhead of high explosive. Each rocket was 245mm in length, weighed 2.6kg and had

A groundcrewman stands on a ladder resting against the starboard wing of BP-20 M52 whilst filling up the propellant tank with C-*Stoff* in April 1945. He wears a protective rubber apron and gloves to protect him from spillage of the volatile fuel compound. The T-*Stoff* filling point can be seen on the top of the fuselage, aft of the canopy. The yellow marking on the wing was used for flight monitoring from the ground.

a nose impact fuse and a self-destroying base fuse intended to ensure that the warhead detonated after a period in flight before it fell back to earth. The rocket was powered by a stick of smokeless powder propellant at the rear of the shell that discharged through a baseplate using seven straight and seven offset venturi to give spin stabilization.

In the planned Ba 349A-1 operational *Natter*, 24 *Föhn* would be loaded into a 53cm-long, nose-mounted 'honeycomb' rack comprising hexagonally shaped tubes. The rack was 40cm across at its widest point, accommodating five tubes, while it was 44cm high, comprising six tubes in a staggered style. Slots cut into the rack's frame allowed the exhaust gases to vent, and panels in the nose joins of the *Natter* were also intended to be blown out to allow further venting. The rockets were to be fired electrically as a 'ripple' over 0.3 seconds, similar to the SG 119. Drawings from December 1944 show an enhanced *Föhn* rack of 48 rockets installed in the Ba 349A-1.

Meanwhile, with pressure on Bachem to complete a manned and fully powered BP-20/Ba 349, in late February 1945 the M22 arrived at the Heuberg. At last, this example was fitted with a Walter HWK 109-509 A1 rocket motor and a dummy pilot, equipped with a parachute, for a powered trial. The aircraft was the heaviest yet at 2,050kg, and while elevons and wing trim tabs had been installed, there were no rudders.

To avoid the very real risk of being burnt from the rocket motor, the electric ignition cables were protected by a steel bracket. The other, perhaps even greater risk involved the 'live' fuelling of the motor with T- and C-*Stoff*. As a result of the experience gained from these very hazardous and volatile fuel compounds with the Me 163s of *Erprobungskommando* 163 and JG 400, a method was devised whereby a tanker truck carrying one of the fuels approached the launch tower first. A member of the groundcrew, holding the filler hose from the truck, would then climb a ladder rested against the right wing, and in the case of the C-*Stoff*, the hose nozzle would be inserted directly into the filling point located on the right side of the fuselage just forward of the wing. The fuel was discharged into the *Natter*'s tanks and then

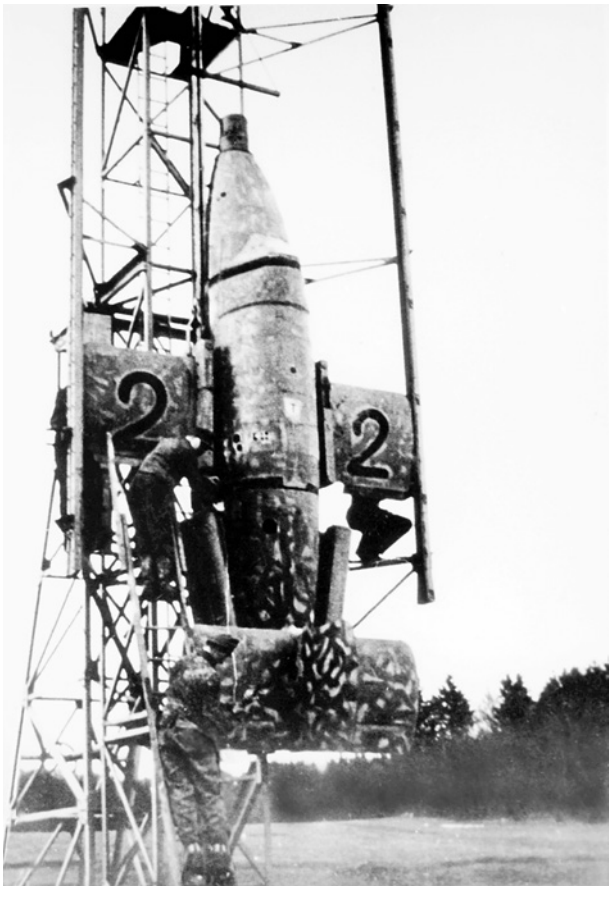
The hazardous reaction caused as a result of mixing T- and C-*Stoff*. Here, a gloved technician allows some drops of sodium permanganate to fall into a dish containing a small amount of T-*Stoff*. The mixture immediately explodes into the oxygen, creating burning hot steam.

the tanker withdrew to a safe distance. The launch site and groundcrew were then thoroughly washed down with water ahead of the arrival of the second tanker carrying the T-*Stoff*, and the process repeated, with the fuel being discharged at a point on the upper side of the fuselage.

The T-*Stoff* was particularly hazardous, since any garments made from combustible materials such as wool or cotton would ignite spontaneously, while contact with skin would result in severe irritation and/or burns. Similar to the technicians who worked on the Me 163, groundcrew were thus clad in overalls made of protective polyvinyl chloride, with synthetic rubber gloves and boots on their hands and feet.

Also borrowed from the Me 163 squadrons was the generator starter trailer, the power from which, most likely controlled from the launch site observation bunker, started the Walter motor.

On 25 February, M22's booster rockets and main motor were fired, producing a loud roar, and the *Natter* climbed up the launch tower. The Walter unit functioned perfectly and the aircraft reached altitude without any problem. The nose separated and the dummy pilot fell free, its parachute blossoming to let it float safely to earth. The two fuselage parachutes also deployed and brought that section down, but some residual fuel ignited and the fuselage caught fire. Overall, however, the fully powered VTO of M22 was considered a success, and shortly thereafter, despite Erich Bachem urging caution so that he and his team could iron out a few remaining issues in further tests, the SS again demanded an immediate *manned*, fully powered VTO. Indeed, it had been during the previous month that both the SS and the RLM in Berlin had ordered that a manned launch take place by the end of February. Bachem had resisted such haste on the grounds that there was no suitable test pilot available. Furthermore, he commented post-war, 'We were also aware that a faulty launch could possibly lead to a halt in the development.'




Finished in an operational camouflage pattern, M22 is prepared for launch from the tower on the Ochsenkopf on 25 February 1945. The *Natter* was fitted with a Walter rocket motor and boosters, and its VTO was successful, with its dummy pilot falling clear after separation of the nose. However, residual fuel caused the landed fuselage to catch fire on the ground.

There were warning signs. On 26 February, M33 took off from the Heuberg along a shortened guideway of 12.5m in a vertical trial intended to test a larger tail unit following concerns over stability at take-off due to the setback of the aircraft's centre of gravity. The machine was fitted with auxiliary launch fins, or *Startflossen*, to the ends of the tailplane, each one metre square, which were fastened by explosive bolts. This extended the span of the tailplane from 2.5m to 4.5m. The extenders would then be jettisoned by detonation of the bolts at the same moment the Schmidding rocket boosters were

Groundcrew rig up a bracket beneath M22, against which they will channel the booster rocket ignition cables to protect them from the blast of the main Walter rocket motor. The man wearing the civilian hat and coat is believed to be Willy Fiedler, Bachem's co-owner and technical director.

jettisoned. At this point, the centre of gravity would have moved forward and the extra surface area would no longer be required.

M33 climbed almost vertically to 800m, but at that altitude one of the SG 34 boosters exploded and the BP-20 broke apart, parts raining to the ground. Damage to the insulation layer between the solid propellant and the metal casing of the Schmidding rocket during production was suspected.

## BREAKTHROUGH – MANNED FLIGHT

On 22 December 1944, a 22-year-old Luftwaffe pilot from I./KG 200, based at Finow, reported for duty at the Bachem-Werk. Lothar Sieber, a native of Dresden, was an experienced airman who had joined the Luftwaffe on 15 November 1939 at Weimar Nohra. His decision had apparently been inspired by an opportunity to shake Hermann Göring's hand at a rally in Dresden in 1936, and from then his career had highlights and low points. Sieber was posted for pilot training to the *Flieger Ausbildungs Regiment* 53 at Gutenfeld, and he made his first flight on 17 January 1940. In the summer of that year, Sieber was assigned to the *Blindflugschule* (blind flying school) at Leipzig-Brandis. On 1 April 1941, he was promoted to Leutnant and transferred to *Grosse Kampffliegerschule* 2 at Hörsching, in Austria. He later joined the *Flugzeugführerschule* C6 at Kolberg, where he flew the Ju 88,

before briefly being located to Dievenow to train as a naval aviator. March 1942 found Sieber with the *Luftdienstkommando* 62 based at Wesermünde, where he flew the He 111, W 34, Bü 131, He 116, Do 17 and He 70.

He later served in Russia, being assigned to Ju 88-equipped IV./KG 51, led by Hauptmann Wilhelm Stemmler, at Bobruisk from November 1942. There then followed a black mark on Lothar Sieber's military record when, on 11 February 1943, he was sentenced to four months' confinement and demoted in rank to Flieger for dereliction of duty while drunk – a sentence that was later commuted to six weeks following a letter of appeal sent direct by Sieber's father to Göring. He was released on 20 June 1943, but his rank was not reinstated.

Sieber is believed to have served with 2./*Versuchsverband* OKL and Major Herbert Heyer's III./TG 4 at some point during 1943. It may have been with this *Gruppe* that Sieber allegedly carried out a loop in a Ju 52/3m transport. In the spring of 1944, he became involved in carrying out trials with the Arado Ar 232 transport, and in the summer of that year he was posted to I. *Gruppe* of KG 200, the Luftwaffe's covert operations wing. Here, amongst other things, he flew in a captured B-17 behind enemy lines for *Kommando Toska*. This unit adopted its name when KG 200 was established in February 1944, having been functioning as 2./*Versuchsverband* Ob.d.L. up until that point. *Kommando Toska* was tasked with conducting operations in the Balkans and eastern Mediterranean areas and was based variously at Kalamaki and Salonika-Mega, from where it flew agent-dropping missions.

On the night of 7/8 November 1944, Sieber took part in a mission to fly a Ju 52/3m of I./KG 200 180km behind Soviet lines in Ukraine to pick up 23 men of *Frontaufklärungskommando* 202 who had been cut off and isolated. They had spent more than five weeks operating in enemy territory attempting to establish links with, and encourage partisan operations by, Ukrainian nationalists. Sieber managed to pick the men up and return at low-level to German-occupied territory. As a result of his deeds, Sieber was awarded the Iron Cross First Class, while Otto Skorzeny proposed he should be awarded the *Deutsches Kreuz* (German Cross) in Gold. One thing Sieber was promised was that he would be promoted to Oberleutnant.

This was the man who would fly the *Natter* in the first piloted and fully rocket-powered VTO, apparently in the hope that after this deed, he would be reinstated with full officer rank. Sieber's courage is beyond doubt.

After familiarizing himself with the Bachem factory and its staff, Sieber travelled out to the Heuberg towards the end of February to observe the *Natter* test launches. Despite probably witnessing the explosion of M33 as well as the flight of M22, he remained undaunted by what lay before him. Indeed, Sieber declared, 'In the course of this war, I have already done riskier things.' The young pilot firmly believed in the success of Erich Bachem's interceptor, although after having been at the Heuberg he decided to draw up his will on 28 February, which he drafted in the favour of his fiancée.

Lothar Sieber had joined the *Natter* test programme on assignment from I./KG 200. An extremely experienced Luftwaffe pilot who had flown many different aircraft, and who had served on the Eastern Front, he became the first man to undergo a rocket-powered VTO.

The next morning, 1 March 1945, Lothar Sieber was driven back out to the Ochsenkopf. He was clad in a one-piece 'combination' Luftwaffe flying suit and carried what appears to have been a summer-issue flying helmet with headphones and shatterproof goggles. The weather had been misty during the morning, but as the day progressed, it had started to clear. Sieber spent some time standing near the launch tower watching the preparations of the groundcrew, who had been informed about the launch the night before.

Sieber was to fly the BP-20 M23. For this test, the aircraft's fuselage section had been fitted with a safety parachute to decelerate it once Sieber had bailed out, as opposed to salvage parachutes which would enable it to be recovered after landing as with M22. There were no trim tabs on the wings, but rudders had been fitted into the tail section and the elevons were enlarged by 20 per cent. The trailing edges of the enlarged rudders and elevons projected beyond the supporting fins. In terms of instrumentation, a pitot tube had been fitted to the right wing to provide airspeed as well as a small number of other controls,

*Natter* M23 is attached to the Heuberg tower in readiness for launch on 1 March 1945. The aircraft has been finished in a crude scribble pattern of dark green over a grey base coat. Note the pitot tube fitted to the leading edge of the starboard wing and the small D/F loop on the rear upper fuselage just aft of the rear joint. The pilot's leather headrest can be seen in the opened canopy, and also visible is the electrical connection cable running from the port side of the fuselage over the booster rocket. The thinner cable also just visible is probably to pull away the main supply cable at the time of launch.

although there was no autopilot – Sieber would be required to hold the aircraft steady and on course during and after take-off. Nor is it believed that M23 was fitted with any kind of radio, although it is possible there was an alternative wired communication link of the kind used in the towed air trials, but this would have been cut at the moment of take-off. There was, however, a small D/F loop fitted to the rear fuselage just behind the rear join.

M23 had been finished in a crude green-grey mottled camouflage, with one numeral of '23' applied to each wing in red. The aircraft was fitted with a red nose cap, and it is possible the four booster rockets were so finished as well. Once fuelled, its take-off weight would be 2,540kg.

Shortly before 1100hrs, after the propellant-filling procedure had been completed involving T- and C-*Stoff*, Sieber exchanged good luck wishes with Erich Bachem. Also present was Willy Fiedler (see Chapter 2), who had only just joined Bachem in February as the firm's co-owner and technical director. Before arriving at Bachem, he had previously worked, under considerable secrecy, on the development of the Fieseler Fi 103R *Reichenberg* manned flying bomb. Both Bachem and Fiedler continued to give Sieber instructions until he began his ascent of the tower. Then the pilot shook hands with the two men. Fiedler recalled:

Clad in his one-piece flight suit, leather helmet and shatterproof goggles, test pilot Lothar Sieber talks with Erich Bachem at the edge of the launch site shortly before he makes his ascent into the cockpit of M23 on 1 March 1945. Three groundcrew wait by the base of the tower to help him enter the aircraft.

'Although I have been present at many hundreds of dangerous rocket launches in the past, I feel conscious of the special conditions of this first manned rocket start as I greet Leutnant Lothar Sieber underneath the high, towering starting rig in the snow-covered valley near Heuberg. While technicians perform their last tasks and engineers check each part of the machine at the launching site, the tank truck arrives with the T-*Stoff* and Sieber and I review once more the starting procedures. While smoking one cigarette after the other, he listens attentively to my instructions. The site is now almost deserted, the tank trucks having left the concrete platform. With her nose pointing to heaven, the *Natter* stands straight up in the starting tower, the steel guide rails glistening in the cold winter morning.'

Despite the proximity of a wooden fuselage and tanks full of volatile propellant, Fiedler asserts that Sieber continued to smoke a cigarette as he climbed the launch tower ladder and onto the little gangway accompanied by three groundcrew. He then stretched out from the steel framework, over the leading edge of the left wing, to clamber awkwardly into the *Natter*'s tiny cockpit. He fastened on his parachute harness and then buckled himself into his seat. A few moments later, the groundcrew closed the canopy and the pilot locked it. Sieber was effectively sitting on his back with his legs directed upwards. As Willy Fiedler describes:

Lothar Sieber grips the handhold on the nose of M23 as he prepares to step off the gangway, which rests on the leading edge of the port wing. Note the seat belt buckle draped over the edge of the cockpit.

'Green flare. Platform empty! Sieber takes a last draw from his cigarette and waves for the last time. The technician shifts the heavy Plexiglas canopy over the pilot, jumps from the starting tower, closes the electric switch and runs into the snow-covered valley. From the command bunker via the telephone I give the last instructions. "All Okay!" sounds Sieber's voice from the speaker. "I'm off."'

A take-off signal rocket was fired from the ground. The *Natter*'s Walter rocket motor was started first and with the craft locked onto the tower, allowed to fire up to full thrust. Minutes later, Sieber started up the Schmidding boosters. Fiedler continues:

'Ten seconds to go. For the lonely man lying on his back in the pilot seat of the *Natter* it must seem an eternity. In the dampened silence of the Heuberg, the red starting flare suddenly explodes. The Walter propulsion unit comes screeching to life and then to full power. A flame emits from the jet stream at the tail and in the steam clouds surrounding the rocket, I see the flames of the four solid-fuel start rockets.'

Then the *Natter* was released and it sped upwards and away from the tower, climbing into the grey stratus-filled sky, streaming twin trails of exhaust from the boosters. At about 100m it veered over at about 30 degrees, at which point the canopy hatch fell away. The *Natter* continued to climb, having reached an altitude of around 1,500m when it disappeared into cloud. Fiedler remembered:

'The moment that the machine is torn loose from its clamps in the tower must mean a feeling of release for Sieber. As planned, the manned rocket rises completely straight up into the air. We stare at its path. Is the pilot conscious, has he survived the starting forces? My hands automatically move to the right as if they handle a joystick that can influence the machine in the air. The trajectory of the projectile begins now to lean backward. The *Natter* rolls a half turn and speeds upward steeply. This manoeuvre I have agreed on with Sieber two minutes earlier, so all must be well; the launch has been successful. But what is this? A dark spot is flying from the speeding machine. Immediately thereafter the *Natter* is enveloped by clouds. "The *Natter* is gone," one of us says. We all stare into the milky clouds. One can still hear the noise of the rocket motor. Thirty seconds … 40 … 50 … then the sound becomes weaker. After 55 seconds I see at a distance of about ten kilometres a black body smash itself straight into the ground. It is the *Natter*.'

The aircraft had actually been airborne for 15 seconds when its rocket motor stopped. Thirty-two seconds later, it rolled over to the right and plummeted in a nosedive back towards the earth. M23 smashed vertically into the ground several kilometres from the launch site, blowing open a five-metre deep crater. According to the subsequent Bachem report, 'During the entire flight the pilot made no move to save himself.' Fiedler recalls:

'Both rocket and pilot are obliterated. It is possible that Sieber had become disoriented during his flight in the clouds and had traversed downward instead of upward. Or it could be that his head had been pressed so violently against the headrest by the slipstream after the canopy flew off that he had lost consciousness.'

M23 had hit the ground in a field near the town of Nusplingen and, aside from the intact cockpit canopy, only a few fragments remained from the impact. Of Sieber, there was nothing left except the remains of two limbs and a piece of skull. A post-war US intelligence report, which was based on a conversation with Fiedler, asserts that 'pilot error' may have been caused by noxious gases from the fuel in the Walter rocket motor penetrating the cockpit and asphyxiating Sieber, but it was further noted that the sudden loss of the canopy, with its integrated headrest, may have broken the pilot's neck. Lothar Sieber was buried with full military honours in Nusplingen cemetery.

The Bachem-Werk Weekly Report issued the day after the launch noted:

'Although the course of events did not turn out as might have been expected on the basis of the technical position and the experience with the first manned free-flight machine, nevertheless the findings that have been gained from the first manned vertical take-off are such that they are to be assessed as unreservedly positive.'

This report also advanced the theory that Sieber may have involuntarily pulled back the control column, which had been set in the neutral position before launch, as a result of the force of acceleration during climb, which reached 3g. Under such force, equivalent to three times his own weight, Sieber's body, including his arms, would have

With one foot on the leading edge of the port wing and another already inside the cockpit, Lothar Sieber precariously straddles the fuselage of M23 as he enters the aircraft. One of the groundcrew holds his left hand to steady him.

been pushed back against the rear cockpit bulkhead and the control column with it under his grip. As a result, the machine would have rolled over and continued to climb in an inverted position. Under such conditions, and with the weight of Sieber's body pressed against the canopy, the lock snapped and the canopy blew away. Whilst the canopy lock of the M8 had withstood slipstream force of up to 600km/h, with M23, the force may have been even greater.

The canopy lock was formed of a handgrip joined to a locking flange, with a pivot point between. The latch flange engaged into the slot of a metal locking plate screwed to the centre of the windshield frame. A photograph of the surviving cockpit canopy appears to show that the locking flange was bent downwards.

Another suggestion was that a semi-dazed Sieber may have shut down the Walter engine himself after 15 seconds of flight, but it was equally possible that the inverted ascent had caused pockets of air to gather in the fuel, thus effecting cut-out.

As the Bachem team investigated the causes of M23's crash and tried to reach conclusions, SS-Obersturmführer Flessner of the *Waffen*-SS *Sonderkommando* issued a memo in which he pressed for a manned flight of the M25 to be undertaken on 5 March. Bachem and his team felt some vexation at the pressure from the SS and the OKL to effect a second manned launch before they were fully ready. To a great extent, Bachem felt that had M23 been fitted with an autopilot system, then what happened with the control column could have been avoided. At this stage, four more test craft were under construction – M13, 14, 24 and 34. Of these, M24 was built as an unmanned model, but installed with a Walter motor and would combine main rocket power with auxiliary launch fins. M34 also carried a safety parachute,

and it was intended to conduct a nose separation. The aircraft was completed on 2 March 1945, and with the Walter engine and full tanks, it weighed 1,980kg. The tests were designed to emulate, as closely as possible, a full operational sequence (aside from carrying a manned pilot and weapons firing).

M34 took to the sky in a VTO on 15 March. All went well, the boosters jettisoning normally, the nose separating and the parachute opening. On recovery, the main hull was found to have sustained damage, but the engine was virtually intact – a cause for encouragement given that in the two other attempts involving a live engine, the units had been destroyed.

The next day, it was the turn of M14. This *Natter* was the first to fly with an automatic guidance system – the 'LGW-*Dreiachsensteuerung*' (LGW 3-axis guidance control) – so as to test the stabilizing effect generated by an autopilot during VTO. It seems the fuselage may have been lengthened on this example in order to accommodate the electronic guidance equipment and the autopilot in a space between the rear of the cockpit and the forward-most propellant tank, which necessitated the introduction of a new frame. Electrical output from the autopilot controlled three servo motors that were connected to the rudders and elevons by mechanical linkages, with a single servo motor controlling rudder movement.

Because the elevons had to control roll as well as pitch, one servo motor had to be assigned to each elevon. These motors were attached to support structures mounted between frames in the rear of the fuselage, one on each side. The linkages were the same on both sides. A rod passed backwards from the integrating unit to a bell crank mounted at the bottom of frame 17. This crank passed the motion directly upwards to another bell crank mounted on the same frame. The upper arm of this second crank was connected forwards by a rod to the servo motor and backwards by another rod to the elevon. To enable the pilot to take over manual control of the *Natter*, switching off the autopilot would have automatically declutched the electric motor within each servo unit.

M14 was powered solely by booster rockets and weighed just 1,320kg. Unfortunately, however, after a trouble-free take-off, the BP-20 began to spiral upwards. The safety parachute opened but failed to prevent a hard impact and M14 was destroyed, with only some items from the recording devices surviving. These had been fitted to monitor control surface activity, as well as fluctuation in flight angles.

A similar set of circumstances occurred during the flight of M34. This machine was completed on 20 March and was at the Heuberg the next day. M34 was not fitted with a main Walter engine and was to be powered solely by Schmidding boosters. It did, however, carry a dummy pilot, an LGW 3-axis guidance system and a safety parachute. After launch, as with M14, M34 commenced a spiralling climb. The boosters were jettisoned, the nose separated despite the failure of the safety parachute to open and the dummy pilot floated to the ground with its parachute. However, without the deceleration of the safety parachute, the fuselage crashed to the ground and was destroyed, except for some measuring instruments.

It is possible that the autopilot roll control was faulty. Dipl.-Ing. Henri Frans Bethbeder, a Dutchman who had studied aeronautical engineering at Stuttgart, and who was Bachem's *Natter* project leader, reported that the three elements of the autopilot had not been properly synchronized, and as a result flight was very erratic. He went on to state that further tests with the autopilot were abandoned until such time that development of the equipment was completed. Undaunted, Bachem wrote, 'The trials with the guidance demonstrated that we were on the right path even if they did not work 100%.'

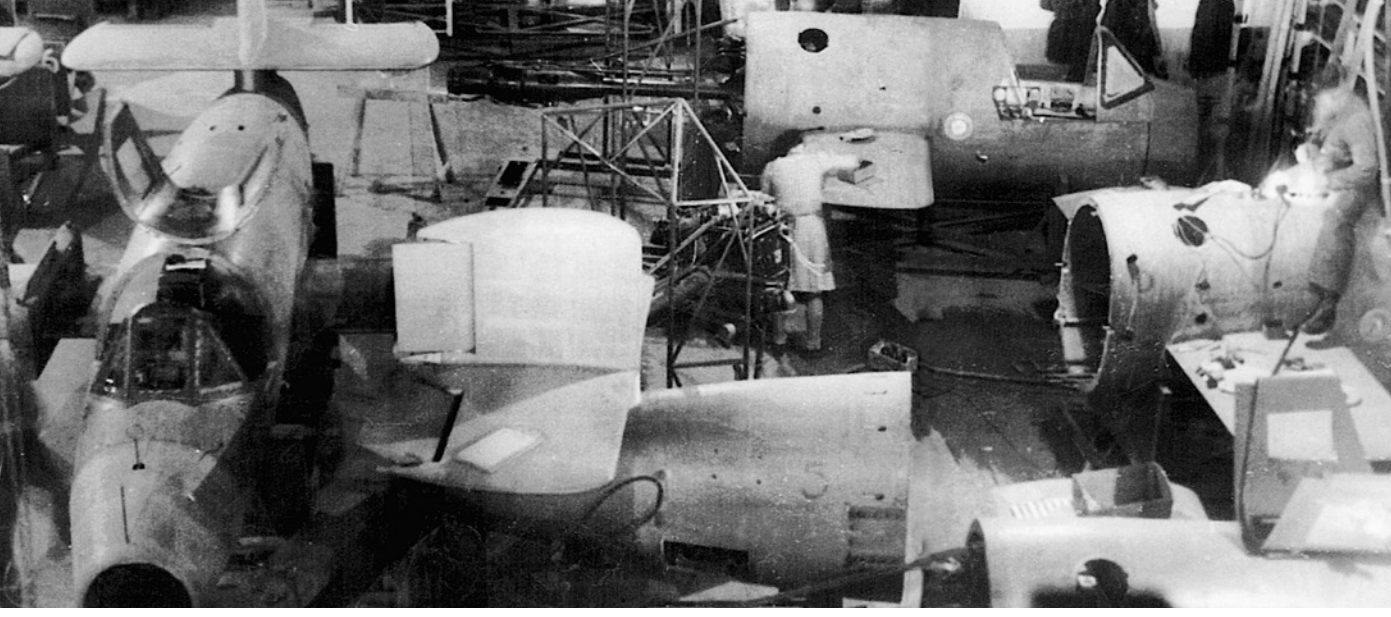
M13 may have been constructed as a back-up for M14, but following the M14 and M34 flights, M13 incorporated some new features. Chief among these is believed to have been the positioning of the booster rockets. It is possible M13 was being used as a 'prototype' for the planned Ba 349B (or BP-20B-01), and thus had its boosters mounted very far back along the fuselage so that their exhaust nozzles extended behind the tail assembly. This resulted in the centre of gravity moving even further to the rear. To compensate for this, booster units may have been made nose-heavy, or as '*kopflastig schiebenden Raketen*' ('nose-heavy pushing rockets').

Weighing a relatively light 1,310kg, M13 was rolled out on 24 March and launched six days later. One of the three boosters failed to ignite, but the *Natter* took off up the tower without problem and went into a spiral climb. This time, the safety parachute opened, but even so the main fuselage was destroyed when it hit the ground.

According to a former member of the Heuberg groundcrew, one more *Natter* was test-launched – M51 – and if this was the case, it would almost certainly have been the last from the steel-framed launch tower. However, there is some doubt about this, and, in fact, if there was one final launch, it was most likely M25, the last experimental example which was known to be under construction on 1 March, but which had still not been launched by the end of the month. This aircraft was intended as the manned back-up for M23, and was fitted with a Walter rocket engine. A surviving photograph that purportedly shows this launch as late as 10 April reveals that the machine had the squared-off lower fin of the experimental models, not the swept-back leading edge of the intended operational *Natter*.

At some stage during the launch, it is believed the booster units failed universally, and the thrust generated from the Walter motor was insufficient to fully accelerate the *Natter* – it went into an inverted flight, attaining an altitude of only 200m before crashing. The aforementioned groundcrewman was apparently seriously injured in the explosion that followed the crash.

Altogether, seven VTOs were attempted after Lothar Sieber's death, but the SS continued to agitate for operational deployment, regardless of how much Bachem wanted to make final refinements to his design. Indeed, by early March 1945, the first elements of a mobile, operational *Natter* launch infrastructure/network were being put in place with which to finally deploy the rocket- or cannon-armed interceptor against USAAF bombers, pushed by the SS, but on the back of Erich Bachem's creative ingenuity.



CHAPTER FIVE

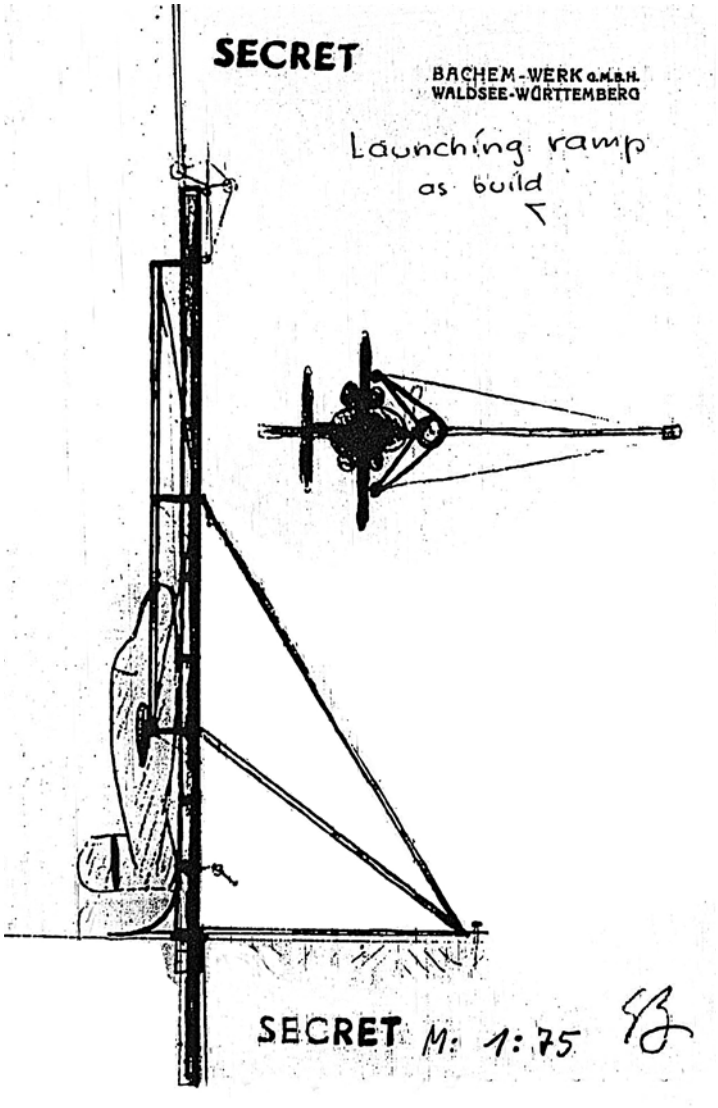
# KROKUS

Production at full pelt at the Bachem-Werk in early 1945. The limited output reflected the relatively small size of the factory and its workforce. Here, the aircraft on the left has been fitted with a honeycomb launch rack for *Föhn* rockets – it also has sight rings. What appear to be propellant tanks are lined up against the far wall.

Throughout March 1945, the Allied air forces continued their relentless bombing campaign against factories, oil refineries and transport hubs across Reich territory. It was usual for raids to comprise up to 1,000 bombers escorted by hundreds of fighters. The pressure on the German civilian and military infrastructure was immense. Allied escort pilots were also claiming increasing numbers of Luftwaffe fighters shot down – when they were not being destroyed on the ground.

It was against this scenario that the SS and RLM decided to implement Operation *Krokus*, the operational deployment of the Bachem *Natter*. To a great extent, their decision had been influenced by the successful and relatively quick deployment of the A4 rocket (the V2), primarily against London, from mobile launch sites set up in urban areas and woods in the occupied Netherlands. The A4 required more sophisticated launch equipment and more personnel than the *Natter*, yet the *Wehrmacht*- and SS-firing batteries were launching hundreds of rockets.

In fact, Bachem had been preparing for high-scale *Natter* deployment for some time – in early January, the company issued a design proposal for a rudimentary mobile launcher known as the *Fahr-Lafette* (mobile launch platform). Constructed mainly of wood, this 12m-long, single-axle wagon could carry two BP-20s resting into a cradle-type guideway with their wings supported by the framework of the cradle. It was a simple but ingenious design. The main trailer would be raised from the ground at an angle of 80 degrees and supported by an A-frame arrangement, with the angled support running from a base timber block to the centre of the underside of the wagon. The entire set-up measured four metres in diameter.




A sketch by Erich Bachem of his *Zündstangen-Lafette* ('ignition pole platform') concept for mass field-launchings of the *Natter*. The poles had the advantage of availability, ease of manufacture and erection, and easy concealment.

From a practical perspective, while the *Fahr-Lafette* offered a cheap and quick-to-assemble launch solution, the launch run of only six metres would probably have been insufficient a length from which to operate the interceptors. It is not believed any such wagons were ever built.

Bachem's other option from around the same time was the ground-based *Zündstangen-Lafette* ('ignition pole platform'). Even more rudimentary in nature, this comprised a vertical pole made from a planed-down tree trunk in the way that they were used for street lights or telegraph poles. A memo issued by the *Sonderkommando der Waffen*-SS at Waldsee on 2 March referred to a possible launch of a Ba 349A-1 on 10 March from the 'new launch mounting'. While not mobile, it was again cheap and simple to erect, requiring minimum personnel and space. It could also be re-used. The idea was to sink a pole two

In a scene that would represent field-launching conditions during Operation *Krokus*, a Luftwaffe officer (seen to the left) oversees the activities of the groundcrew as M52 is hoisted up towards its launching pole in April 1945.

metres into a concrete foundation, with the pole rising to 15m above ground level. Attached to the pole was a single steel launch guideway (*Führungsschiene*) that ran to a point around two metres from the top. This was more than adequate in length, given that the requirement was for nine metres. The pole would be strengthened by ten eight-metre-long outriggers placed two metres apart, which also supported a stationary *Natter*. Near the base, a guide lever would connect to an azimuth or compass-bearing scale.

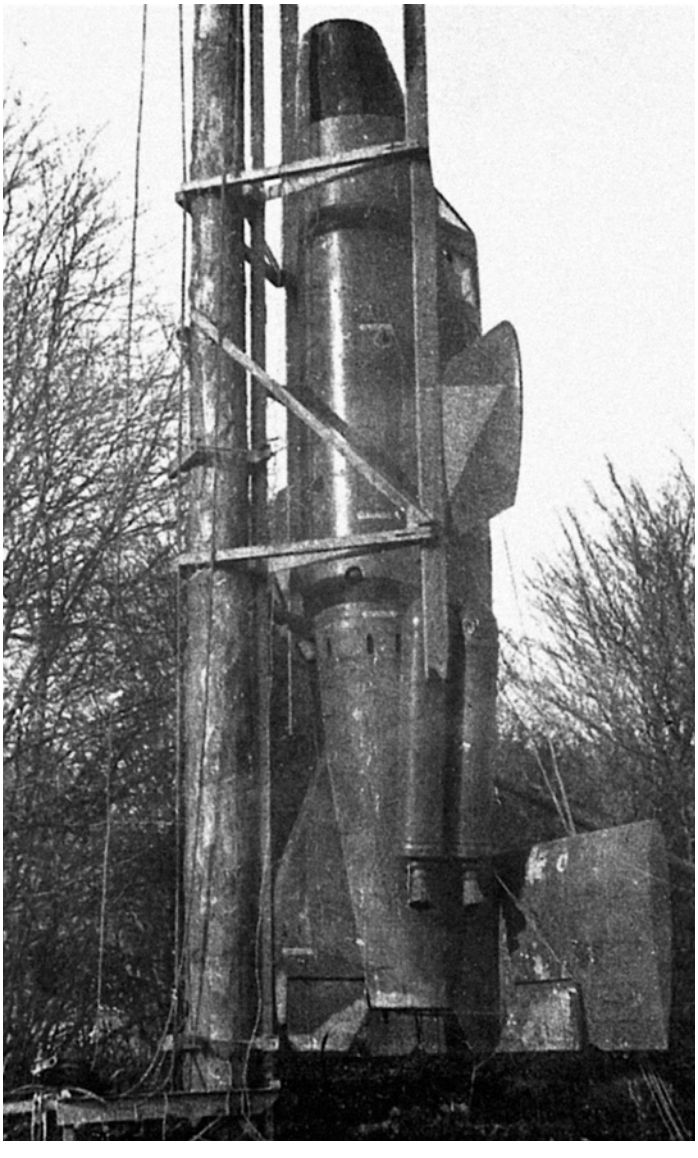
The Ba 349A-1 was designed intentionally to be launched from a pole in operational conditions, being fitted with a guide shoe mounted on the fuselage underside and a rear shoe on the edge of the lower tail fin. Four such machines were ready for testing by the beginning of March. All this effort was negated, however, because of delays with the Walter rocket motors – specifically, the starting equipment for the HWK 109-509 1,700–2,000kg-thrust engine needed for the Ba 349A-1. Furthermore, following the recent series of tower test launches, there was concern over the Schmidding booster units. Indeed, the Bachem-Werk requested that Schmidding send an engineer to Waldsee to assist with further trials. To counter this problem, it was suggested that an alternative booster rocket be considered of a type manufactured by Rheinmetall, two of which would offer a greater performance than four Schmidding units. Ultimately, however, it seems nothing came of this.

Meanwhile, in an illustration of the fluid organizational handling of *Krokus* – so-named because the crocus bloomed during the month of

A tense moment – M52 appears to hang suspended at 45 degrees as it is lifted towards the launch pole. This photograph clearly reveals that the pole is little more than a stripped-down tree trunk. M52 was finished in overall green, with the nose cap and booster rockets in red. The four varied markings on the wing surfaces were in yellow, and intended for monitoring flight from the ground.

March when it was intended to mount the first attacks against Allied bombers – on 1 April, the OKL ordered the *Kommando der E-Stellen* (Luftwaffe Test Centre Command) to form, with immediate effect, a new unit to be known as *Erprobungskommando* (E-Kdo) 600, whose CO would have the equivalent authority of a battalion commander. The task of E-Kdo 600 was 'the development and operational testing of the *Natter* device for frontline readiness.' The *Kommando* was to be placed under the operational jurisdiction of SS-*Gruppenführer* and *Generalleutnant der Waffen*-SS *Dr.-Ing*. Hans Kammler, who acted as Hitler's personal 'Plenipotentiary for Jet Aircraft Production and Operational Deployment'.

Kammler had already gained notoriety for his personal and clinical coordination of the A4/V2 firing campaign against London and continental targets. Towards the end of March, Hitler had ordered that he was to command all necessary development, testing and production of jet aircraft and to coordinate all necessary logistic operations previously handled by the Minister for Armaments and



If Operation *Krokus* had progressed, this is what, in theory, would have faced the Allied air forces from the spring of 1945 – large numbers of *Natter* interceptors able to be launched from cheap, quick-to-produce, quick-to-erect, easily concealed launching poles. Armed with batteries of air-to-air rockets, *Natter*s, if launched simultaneously and deployed in numbers against enemy bombers, could have caused carnage – provided properly trained pilots were available in the same numbers. Here, M52 is secured to a launch pole in April 1945.

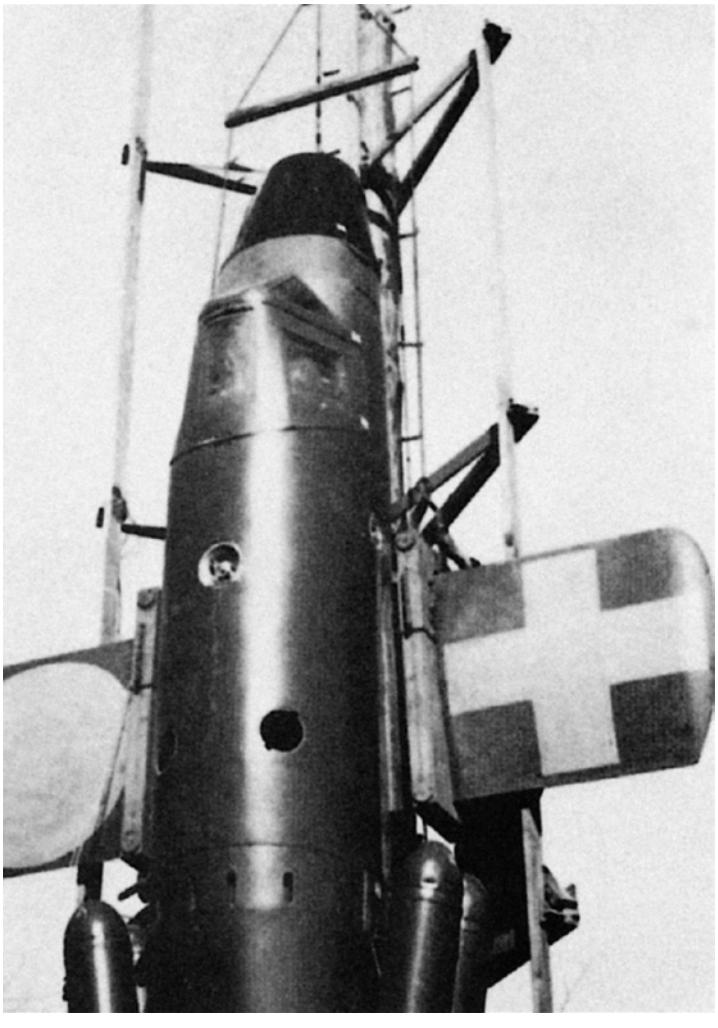
War Production. Kammler was also to assume command of jet production through to operational deployment. According to Hitler's decree, 'Kammler is placed under my personal command and has my fullest authority. All Commands of the *Wehrmacht*, Party and Reich organisations are to assist him in the execution of his duties and are to carry out his orders.'

By the beginning of April, one *Natter*, M52, had been made ready as a Ba 349A-1 and fitted additionally with auxiliary launch fins for unmanned trials with the *Zündstangen-Lafette*. The *Natter* had been finished in an overall green and had its wings marked with distinctive yellow shapes for monitoring purposes from the ground once airborne. It was hoisted carefully by a crane truck from the flat-bed trailer on which it had been delivered to the Heuberg and then secured to the guideway on the wooden pole about 1.5m above the concrete foundation. This cumbersome process took some time and involved a team of about ten men. The *Natter* was then fuelled with C- and T-*Stoff* by a technician in a protective gown and gloves from a ladder mounted against the right wing. The wing clamps and hoisting harness were then removed. The electric start-up cables were connected for the HWK motor and the ignition of the booster rockets.

The launch is believed to have been performed without problem, M52 climbing to 2,200m after the booster rockets had burned out. During its ascent, the leather dummy pilot was ejected and both the 'pilot' and the *Natter* returned to the ground beneath their respective parachutes without damage. Effectively, the launch of M52 marked the practical end of *Projekt Natter*.

On 1 April 1945, Adolf Hitler relocated his headquarters from the Chancellery building in Berlin to a deep bunker complex just behind it. It was a move redolent of defeat. In Moscow that same day, Josef Stalin enquired of his commanders, 'Well, now, who is going to take Berlin, we or the Allies?'

The start date for Operation *Krokus* slipped back, officially, to



M52 is held against a *Zündstangen-Lafette* by its wing clamps locked over the wing roots. Access for groundcrew up the pole was via spikes hammered into the tree trunk at intervals.

20 April, Hitler's birthday. At the Bachem-Werk, it was planned to have 15 *Natter*s – M51 to M65 – to be built between 23 March to 20 April, making them available for the commencement of *Krokus*. Photographic evidence survives to show the partially completed operational machines in the Bachem factory fitted with 'honeycomb' nose racks for 24 *Föhn* rockets, as well as crude sights mounted on the nose. By mid-April, however, American forces had reached the Waldsee area. To what stage E-Kdo 600 had advanced, if any, in terms of its establishment is not known, nor is its fate. Bachem staff, no doubt 'encouraged' by the SS, who were possibly acting under orders from Kammler, loaded a number of the interceptors onto trailers and drove them away in an effort to stay one step ahead of the Allies. The SS still had plans to launch them against the bombers. However, following the cessation of hostilities, Allied troops captured four lightly damaged A-1 *Natter*s and technicians at a DFS airfield near St Leonhard in Austria. For Bachem and the SS, it was too little, too late.

CHAPTER SIX

# WHAT IF?

American troops examine several *Natter*s abandoned on trailers at a DFS facility in an Alpine valley at Sankt Leonhard im Pitztal in western Austria in May 1945. Note the crude method of placing tree branches over the aircraft in an attempt at camouflage. The honeycomb nose launcher is clearly visible in the machine to centre. These examples were effectively Ba 349A-1 operational machines that had been evacuated from the Bachem-Werk on orders from the SS shortly before the arrival of the Allies.

How realistic was the notion of the skies over the Third Reich teeming with Ba 349 *Natter* interceptors attacking Allied bombers? What would have happened? The answers to these questions lie somewhere between the realities facing Bachem and the SS, and the strategic progress of the war. In all, it is believed that by the end of the war, 36 *Natter*s had been produced, of which ten were A-1 operational types. Against raids of several hundred bombers, the likely physical damage that they would have inflicted would have been minor. But, in the same way that the appearance of Me 262 jet fighters caused consternation among Allied air commanders and crews, the sighting of the *Natter* in daylight so close to a target, let alone any destructive effect it may have had, would have sent alarm bells ringing within the USAAF.

Fully armed, and flown by a capable pilot, the *Natter* could have proved a formidable weapon. When R4Ms were fired by Me 262s into formations of B-17s and B-24s, destruction was caused not only by direct hits, but also by the psychological effect of ripple-waves of the rockets streaking through a formation, inducing blast, panic and confusion. The *Natter* may well have had the same effect, with much less of a window of opportunity for escort fighters to respond.

In the design, development and manufacture of the He 162, the Germans had proved that they were able to produce a jet-powered fighter in a matter of weeks, using cheap, readily available material (wood) with assembly farmed out to a network of sub-contractors. It was a system that basically worked, and it was not until the final days

of the war that the transport network collapsed and the effect of Allied bombing raids brought Heinkel to a standstill.

Erich Bachem's concept of *Zündstangen-Lafette* was inspired, for the one thing the Third Reich still possessed a considerable quantity of by March 1945 was timber. The raw material to make such poles could have been sourced locally to any given zone of operations, and the skills needed in bringing a pole to readiness could be found in the forestry workforce. This means that a network of poles could have been erected all over Germany, or at least wherever they were needed. They were also quick and simple to erect, and would have been difficult to spot from the air.

Aside from being cheap to build, the Ba 349 was relatively light and transportable, although resources would need to have been found to effect recovery of hull sections once they had come down after a mission. Due to the limitation in the *Natter*'s range, this would not have been far away from a launch site.

The problem was pilots – or the lack of them. Put simply, by the spring of 1945, where would the SS or the OKL have found sufficient numbers of aviators adequately trained and physically fit enough to fly and withstand the aerodynamic forces involved in piloting a rocket-powered VTO interceptor? The flight made by Lothar Sieber highlighted the dangers to the human body. And not only was this a question of flying skills, for in the same way that Me 262 pilots found the speed of the jet fighter challenging to balance with weapons such as the MK 108 cannon or the R4M rocket, so the pilot of the *Natter* would have had to be proficient in firing a honeycomb of 24 *Föhn* rockets, gauging range and making his aim count.

In the immediate post-war years, as the prospect of a 'Cold War' scenario grew ever warmer, in Britain at least there was need for a high-speed point-defence interceptor to combat the prospect of Soviet long-range bombers operating from newly gained bases in western Europe against British industrial targets. The furthest work in such a direction ever got was in the investigations conducted by the Fairey Aviation Company into VTO aircraft. Trials were carried out in 1950 using models powered by a Beta 1 rocket motor designed by the Royal Aircraft Establishment, but built by Fairey and powered by concentrated hydrogen peroxide and methyl alcohol with hydrazine hydrate, the equivalent of T- and C-*Stoff*. The trials moved from Wales to Australia, where launches were carried out at the Woomera Rocket Range in South Australia. Ultimately, however, the prospect of a rocket-powered VTO fighter was brushed aside in favour of ground-to-air missile systems.

While *Projekt Natter* may have faded to become yet another fascinating footnote of aeronautical history, there is no doubting the expertise, dedication and courage displayed by those who took part in it.

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**Front Cover**
Fast approaching 600km/h, Bachem *Natter* M23 blasts skywards from its launch tower at Heuburg, Germany, on 1 March 1945. It was flown by Lothar Sieber in what was the world's first rocket-powered, manned, vertical take-off. Despite its subsequent fatal crash less than a minute later, the M23 represented the first, radical step in a new dimension of aeronautical development.